THURSDAY, JANUARY 8, 1920.

WATER-POWER AND DARTMOOR.

THE proposal to develop electrical energy from water-power on Dartmoor has led to a strong protest against interference with the amenity of the moor as appreciated by the lovers of solitary places. Mr. Eden Phillpotts first directed attention to the matter by a letter in the *Times* of December 10, in which he called on the Duchy of Cornwall, the landlords of Dartmoor, to act quickly "and help to create a body of Parliamentary opinion; otherwise the destructive and ill-considered enterprise may receive sanction from an indifferent House of Commons next session." A Plymouth correspondent supplied to the *Times* of December 23 an account of the scope of the proposed scheme, and on later days other writers expressed their strong disapproval of the project from local, engineering, or æsthetic points of view. Unfortunately for a journal which desires to review the situation justly, the supporters of the scheme have not taken part in the newspaper discussion, and as we have not seen the Bill in question we can judge of its provisions only from the statements of its opponents, and must accordingly assume an attitude which may appear more critical of the upholders of the *status quo* than our sympathies would have dictated had we access to both sides of the question.

To many lovers of Nature, Dartmoor has already suffered disenchantment by the grim associations of the prison which has been established there for a century, and there may be some who object to the system of leats which for a still longer period has supplied water to the towns on its fringes. The correspondence referred to does touch unfavourably on the modern waterworks which supply Plymouth, Torquay, and Paignton, but these are accomplished facts, and serve merely to strengthen the opposition to new interference with the moor and its rivers.

The scheme of the Dartmoor and District Hydro-electric Supply Company is briefly to utilise the great rainfall and high altitude of Dartmoor in the generation of electricity at several power stations situated on different streams, to convey the current to the neighbouring towns and villages for ordinary municipal purposes, and possibly to erect industrial establishments where current might be used for electrolytic or power purposes. It is claimed that this work will furnish needed employment for the population of the district, provide a continuous and economical supply of electricity for lighting, traction, and heating, reduce the congestion of railway traffic by diminishing the demand for coal, and generally increase prosperity and confer public benefits more than sufficient to counterbalance any interference with agriculture, fishing rights, or the pleasure of visitors to the Moor.

The general, and especially the local, public is not qualified to weigh the rival claims, and as things now stand Parliament must proceed by the old, cumbrous, and very costly method of hearing eloquent advocates and technical experts on all the points raised.

No one is now likely to deny the general applicability of the rule that private convenience must give way to public advantage; but there is still a great deal of confusion as to the criteria by which the conflicting claims should be judged. It is in our opinion essential that all matters connected with the use of natural resources should be investigated by experts whose personal interests are not involved in the case. It is of equal importance that full and impartial information should be available before a decision is arrived at. In the present instance no one knows what the available rainfall on Dartmoor really is, but this can be ascertained if an average rainfall map is constructed from the data which are accessible and according to methods which have been established. The available fall between reservoirs and power-houses can be found by direct surveys guided by the existing Ordnance Survey maps.

The cost of the necessary engineering works is a more difficult and practically a more important question, as no one can foresee the price of materials or the value of the pound note during the years which must elapse before the works can be completed. The size of the dams required in forming reservoirs and the depth of their foundations, on which any estimate of cost must be based, can be ascertained only by detailed surveys and numerous borings, which experience of private Bill legislation has taught us are not always carried out before the Bill is deposited. The danger of underestimating the cost is less likely to be incurred by a company which depends on the scheme showing a profit when carried out than by a public authority which does not labour under that wholesome disability. In other aspects, however, the exploitation of natural resources by public authorities is more likely to be to the public interest, and certainly more likely to secure general confidence.

X

At present the whole question of the water resources, and especially of the water-power, of the British Isles is being investigated by a Committee of the Board of Trade, and on this account Parliament may be inclined to postpone the consideration of private Bills dealing with water, if not of special urgency, until the Committee has reported. There are few areas in England where an unused gathering-ground exists at an altitude allowing of the development of water-power, and it may well be considered inexpedient to allocate them finally before a hydrometric survey has been carried out to enable the available power and its cost to be calculated on a sure basis before work is commenced.

RADIO-COMMUNICATION AND THE THERMIONIC VALVE.

(1) *The Thermionic Valve and its Developments in Radiotelegraphy and Telephony.* By Prof. J. A. Fleming. Pp. xv+279. (London: The Wireless Press, Ltd., 1919.) Price 15*s.* net.

(2) *Text-book on Wireless Telegraphy.* By Prof. Rupert Stanley. New edition in two volumes. Vol. i.: *General Theory and Practice.* Pp. xiii+471. Vol. ii.: *Valves and Valve Apparatus.* Pp. ix+357. (London: Longmans, Green, and Co., 1919.) Price 15*s.* net per vol.

(1) SCIENTIFIC workers who desire to learn something about the latest developments in radio-communication generally find that books on the subject are either scientific but too technical, or not sufficiently scientific and so useless for their purpose. It is little use to have illustrations of the kenotron, the pliodynatron, the ultra-audion, and the tungar, with diagrams of their connections, unless we have also some reasoned account of their mode of action. The reader soon tires also of vague accounts of the electron theory, which is regarded by some authors as a kind of fetish which must never be criticised and the mere mention of which is supposed to explain everything.

In the first chapter Prof. Fleming gives an interesting and instructive historical introduction. So far back as 1883 he read a paper to the Physical Society describing the molecular radiation in incandescent lamps with horse-shoe filaments. He proved that the blackening of the bulb was due to the scattering in straight lines of carbon particles from the filaments, one leg of the horse-shoe filament protecting a long strip of the bulb from being blackened.

Later in the same year Edison discovered that a current would flow between the positive terminal of the filament and a metal plate sealed in the bulb. In those pre-electron days the phenomenon was considered by electricians hopelessly puzzling. In 1897 Sir J. J. Thomson first published an account of his demonstration that negative electricity is always associated with certain masses about 1800 times smaller than the mass of an atom of hydrogen, and that under certain conditions these electric corpuscles are emitted from hot bodies. It then became possible to give a scientific explanation of the Edison effect. It was not, however, until 1904 that Prof. Fleming published his master patent, which proved the utility of the Edison effect in radio-telegraphy.

The Fleming valve, which is the parent of all the thermionic valves, allows electricity to flow from a heated filament to a cylinder, both being enclosed in a vacuum bulb, provided the cylinder be at a higher potential than the filament. If the potential be lower than that of the filament, then practically no current flows. The device thus acts as a true valve, allowing current to flow in one direction, but not in the other. The high-frequency currents in the aerial can thus be rectified, and the consequent gushes of electricity in one direction can magnetise the electromagnet of the telephone and thus produce a sound.

In chap. iii. a description is given of several types of three-electrode valve and of the various ways they can be connected up. Special stress is laid on the historical side of the development of this valve. In chap. iv. we are told of the discovery that the three-electrode thermionic valve could in certain circumstances act as a generator of oscillations. It would be of interest to know who suggested to Meissner that he should try whether it was possible to make the thermionic relay into a generator. Whoever it was deserves great credit for his suggestion.

Prof. Fleming points out how analogous the action of the generator valve is to that of the "humming telephone," which has been known to electricians for the last twenty-five years, and also, but not so obviously, to that of the Duddell arc.

The great advantage of the thermionic valve as a detector in practical work is that it is not liable to be damaged by electric atmospheric discharges, which often cause endless trouble when coherers or crystal detectors are employed. In chap. v. the uses of the thermionic detector in radio-telephony are described, the complicated diagrams being quite easy to follow, partly because of the use of the excellent system of symbols standardised by radio-engineers. In chap. vi. descriptions are given of the methods of using thermionic devices in radio-telephony. We are pleased to note that due credit is given to H. J. Round, of the Marconi Co., for his numerous inventions.

In the concluding chapter an account is given of some recent improvements in thermionic devices mainly developed during the war. There are several suggestive methods of testing the efficiency of radio-apparatus described in the book, some of which are due to the author. There is also, perhaps naturally, a great deal about the law case between the Marconi Co. and the De Forest Radio Co., which ended so triumphantly for Prof. Fleming. We can heartily recommend the book to all scientific readers.

(2) The development of the art of radio-communication during the war has forced the author to expand his text-book into two volumes, the second volume being mainly devoted to vacuum valves and valve circuits. In writing the first volume Prof. Stanley had in view the needs of wireless operators and amateurs. He was impressed by the lack of a text-book on electricity and magnetism suitable for radio-students. We are told that the existing text-books do not discuss sufficiently fully induction, oscillatory currents, and the true significance of "magnetic or electric lines of strain in the all-pervading ether." In the author's opinion the electron theory will present fewer difficulties to the student than the "vague fluid theories which it has replaced." The reviewer read, therefore, his introductory chapters, giving an elementary *résumé* of the latest theories, with an open mind and with considerable interest.

The impression produced on him, however, was very disappointing. The student is at once introduced to electrons. He is told that there are 10^{23} free electrons in a centimetre cube of metal, that electricity is a constituent of all forms of matter, and that "a unit of negative charge is an electron, and a unit of positive charge, etc." He is told this before negative or positive charges are defined. On p. 13 he has to answer the question, "If the electron theory is taken as the correct one, what is electricity?" Potential (p. 23) is defined as follows: "The electric strain in the ether available for making an electric current flow through the medium is called the electric pressure, or potential, and is measured in units called 'Volts.'" This is certainly not the academic definition of potential, but it is getting perilously near the "vague fluid theories." We are told that "if two bodies of the same size are charged equally with 'positive or negative electrification' there is no difference of potential between them." This is misleading. It is true in free space, but if there are any other bodies in the neighbourhood it is probably not true.

Some of the definitions are carelessly given. The joule, for instance, is defined to be the work done by one ampere of current in flowing between two points, A and B, when the difference of potential between A and B is one volt. Similarly, in the definition of the erg (p. 42), the "per second" is left out. The dielectric constant is defined (p. 55) as "its effect when used as a dielectric as compared with an air dielectric." This is unintelligible. The formula for measuring the mutual inductance between two coils (p. 78) is wrong; it should be $M=(L_1-L_2)/4$. There is a misprint also in the formula for the time given on p. 82. The rest of the first volume is mainly concerned with ordinary radio-practice and is readable. Some of the diagrams are admirably clear.

In the second volume the author begins, very properly, with a recapitulatory chapter on "electrons." The theory of the thermionic valve is mainly concerned with the passage of electricity through gases, and the electron theory explains this admirably. As the author was chief wireless instructor with the B.E.F. in France he is thoroughly at home when describing the systems and apparatus used by the Allies in their wireless services. Radio-engineers will find the chapters on continuous wave (c.w.) transmission and on radio-telephony useful. A. R.

CATALYSIS.

Catalysis in Theory and Practice. By Dr. Eric K. Rideal and Prof. Hugh S. Taylor. Pp. xv+496. (London: Macmillan and Co., Ltd., 1919.) Price 17*s.* net.

THE whole subject of catalysis stands in a peculiar position. For many years it has attracted investigators on the purely scientific side, who have added greatly to its scope in respect both of new material and of theoretical speculation. It is being actively pursued along both lines at the present time. There are also its vast technical applications, many of them already well known, to which addition is being constantly made, and wherein new fields are rapidly opening up, of which the modern chemist must take cognisance. Yet, in spite of all this, we should be hard put to it to distinguish clearly between a catalytic and a non-catalytic process. The so-called catalytic criteria are not really very helpful. Ultimately the term "catalysis" will probably vanish from chemical literature as our knowledge of the mechanism of chemical processes advances, though the term may remain for long as a convenient, though arbitrary, term of classification. But we are very far from this state of affairs at present, and there is the greatest possible need that the importance of the subject should be emphasised and its immense possibilities clearly indicated. We find this well brought

out in the book before us. A brief enumeration of the contents will give an idea of what the authors have attempted.

After a short historical outline and a consideration of catalytic criteria, we are brought to the subject of promoters. There is a brief discussion of the possible mechanism of promoters, and it is pointed out that the beneficial effect of several promoters present simultaneously "may be due to the greater range of temperature over which at least one of the oxides is unstable or labile." In connection with induced or mutual effects, Liveing's views are given their just prominence.

Chap. iii. contains valuable information of a kind not usually met with in a text-book—*i.e.* such points as space-velocity and space-time yield—together with a short description of the authors' apparatus for the quantitative measurement of heterogeneous catalytic processes.

In the succeeding chapter oxidation processes are considered, viz. the manufacture of sulphuric acid, salt cake, the oxidation of ammonia to nitric acid, the manufacture of chlorine, the oxidation of sulphuretted hydrogen, the purification of illuminating gas and gaseous fuels, surface combustion, catalytic oxidation in the dye industry, the drying of oils, and other processes. Incidentally, the necessity of a sound knowledge of the thermodynamics of physico-chemical processes is made evident.

Chaps. v. and vi. deal with the manufacture of hydrogen and with processes of hydrogenation and dehydrogenation. These include some of the most recent and important developments of applied chemistry. The authors in these chapters, as elsewhere in the book, have added greatly to the interest and value of their work by useful suggestions regarding the directions along which further advances are likely to be made or are most urgently required. (As a minor point one might query the meaning of the data attributed to Rittman on p. 217.)

In chap. vii. we pass to a consideration of the all-important problem of the fixation of nitrogen, especially by the Haber process, which has attracted so much attention recently in the Allied countries, and upon which the authors write from first-hand knowledge, though too briefly.

After dealing with hydration and hydrolysis in chap. viii., in which such subjects as synthetic alcohol, the manufacture of glucose, and the Twitchell process are dealt with, the authors return in chap. ix. to reactions of the "Sabatier" type in their account of dehydration processes, consideration being given at the same time to dehydrations in homogeneous systems.

To a very large extent the preceding chapters are devoted to catalytic processes of technical importance—actual or potential. In chap. x. our attention is directed to a different aspect of the field, namely, the *rôle* of catalysis in organic synthesis, in which such topics as the Grignard reagent, the Friedel-Crafts reaction, halogenation, the aldol and benzoin condensations, dynamic isomerism, racemisation, and muta-rotation are discussed, on the whole, rather too briefly perhaps.

In chap. xi. ferment and enzyme action is taken up. Here we find catalysis the dominant characteristic, serving as the link between chemistry on one hand, and physiology and bacteriology on the other. This chapter is particularly good. The authors acknowledge their indebtedness to Prof. Bayliss for his criticism of the treatment given.

In the next chapter we are brought to the consideration of yet another field—namely, catalysis in electrochemistry, a subject in which catalysis plays an important but, on the whole, little recognised part. It is of the greatest value to have this aspect emphasised. The problems dealt with are: cathodic reduction, anodic oxidation, and passivity.

The concluding chapter is entitled "Catalysis in Analytical Chemistry." It is a familiar subject considered from a somewhat novel point of view. The treatment is comprehensive and sufficiently detailed to give the reader a true impression of the *rôle* of catalysis in this fundamental branch of chemical training and practice.

The book is excellent. It is indispensable, in fact, to everyone interested in chemical science whether on the academic or on the applied side.

W. C. McC. L.

THE NEGLECTED STUDY OF PROBABILITIES.

Calcolo delle Probabilità. By Prof. Guido Castelnuovo. Pp. xxiii + 373. (Milano-Roma-Napoli: Società Editrice Dante Alighieri di Albrighi, Segati e C., 1919.) Price 20 lire.

AMONG the sins of omission for which mathematicians and teachers of mathematics might be charged, there is probably none which has so vitally affected our national welfare as the neglect of the study of probabilities. Into every event of ordinary life considerations of probability enter in a greater or less degree, and for this reason every boy or girl who has learnt to use vulgar fractions ought to be taught to apply them to simple games of chance, and in this way to illustrate the rules for fractional addition, multiplication, and so forth. In default of this knowledge, millions of pounds are spent on postal

orders in response to attractive offers of hundred-pound prizes the expectation value of which is not one-tenth of the price paid. Yet it was only recently that the Central Welsh Board excluded probabilities from an examination syllabus in algebra which was simply loaded up with questions on collections of letters and symbols that could convey no meaning to the victims of the examination system.

Other applications are to such problems as life assurance and statistics. In the former the calculations must, of course, be largely left to experts, but the public ought to acquire an intimate familiarity with the nature and meaning of probability and expectation and their numerical representation in order properly to appreciate the transactions. This elementary knowledge should come under arithmetic, not algebra. As for statistical applications, the systematic way in which parliamentary electors are misled for lack of understanding these things is evident. They have not realised that when wages go up prices also go up.

Now Prof. Castelnuovo's treatise strikes the reviewer as just the kind of book of which it would be worth while to publish an English translation. It is a long time since we had a standard work on the subject on similar lines, and in the interval our notions on teaching mathematics have certainly moved in a practical direction. Prof. Castelnuovo's book well meets the situation. Of course, the treatment is mathematical and the calculus is freely used, but the formulæ are introduced as statements of principles rather than as purely algebraic relations, and the whole treatment centres largely round practical applications. Any B.Sc. candidate would find the book quite easy reading, and the subject very useful in connection with physics, biology, philosophy, or, indeed, any branch of science, even including that all-embracing subject, aeronautics. A special feature on the more advanced side is the account given at the end of the discoveries of Tchebychef, who is quoted as having made the greatest contributions to the subject after Laplace.

Of course, the initial difficulty lies in the definition of probability, regarding which Prof. Castelnuovo's treatment both in the preface and at the beginning of the text is probably as good as the circumstances permit. There is no unique definition of probability, and in most cases no unique measure of its value. The old definition by an event which may happen in m ways and fail in n ways postulates a preconceived condition of "equal probability" for the m and n ways. There are, as Prof. Castelnuovo points out, many cases, in particular in games of chance, in which this postulate is admissible and the measure of probability has something like a unique value. But in most cases the estimated probability of an event depends on the extent of knowledge possessed by the person making the estimate, and, indeed, is a continually varying quantity depending on the progress of previous events. No two people would assign the same measure to the probability of a certain candidate passing an examination, and, indeed, the estimated chance varies continuously until the appearance of the list (sometimes even afterwards!). All that we can do in place of a definition is to substitute numerous examples in which the measure of probability is free from ambiguity. The nearest approach to a definition is given by the rules for compounding probabilities, of which the above-mentioned old definition is a particular case, with the additional convention that the probability always lies between 0 and 1, and that after an event has happened we must substitute 1 for the probability of its happening and 0 for the probability of its failing in our future estimates of the probabilities of dependent events. In fact, the theory of probability owes its existence to ignorance of future, and partial ignorance of past, events.

Attention has been frequently directed by the reviewer to energy running to waste among our mathematicians which could be utilised in connection with aeroplanes. In our universities a great deal of waste energy in the departments of pure mathematics could also be utilised by turning out graduates with a knowledge of probabilities and statistics which would filter down through the teachers to the elementary schools and thus to the citizens of the future. And for a start at the top of the ladder, Prof. Castelnuovo's book seems excellent.

G. H. BRYAN.

THE STUDY OF THE FAMILIAR.

A Source Book of Biological Nature-Study. By Elliot Rowland Downing. (The University of Chicago Nature-Study Series.) Pp. xxi+503. (Chicago, Illinois: The University of Chicago Press; London: The Cambridge University Press, 1919.) Price 3 dollars net.

IT is encouraging to read that never before has there been in America "so insistent a demand for a more thorough and more comprehensive system of instruction in practical science." To direct this demand, Mr. Downing is editing a Nature-study series, and has written a source book for the biological side. It aims at showing students in schools of education and teachers at work what materials are readily available and

how these may be effectively used. "It undertakes to make significant some of the commonplace environment and to suggest ways in which living material may serve educational ends." Great prominence is given to material which has social and practical interest, but the danger of fostering a one-sided utilitarian outlook is guarded against. "The great contributions of science to the life of mankind are: its emphasis on the scientific mode of thinking or the problem-seeing, problem-solving attitude of mind; a mass of scientific knowledge that serves as the basis for desirable skills; and an interpretation of Nature productive of an inspiring appreciation, both intellectual and æsthetic, of her phenomena. Science instruction needs to assure these things to the individual pupil." These are clearly defined aims, and the book appears to us to be highly successful in all the three directions indicated—in setting problems and cultivating the curious spirit; in showing that Nature-study makes for efficiency as well as for understanding; and in cultivating a reasonable love of Nature. A note with fine resonance is struck when the author declares his ambition to treat his material so that "the everyday things may stand revealed as the wonders they really are."

The book deals with animals of pond and stream, insects and their allies, birds, gregarious animals, wayside flowers, common trees, seeds and seedlings, the garden, and spore-bearing plants. Each chapter has its list of references; there are practical hints as to material; the illustrations are abundant and interesting. They include some pupils' drawings. There is a genuine attempt throughout to get at the child's point of view and to use its judgment of values. "The teacher needs to take much of the foolishness of childhood along with her, and needs also to be persuaded that it is not altogether foolish." But there is no namby-pamby nonsense. We wonder a little, however, at some of the phrases which are unfamiliar to us, such as the chick's egg or the chicken's egg. Why not the hen's egg, and be done with it?

Of the many features which are admirable, we may give a few illustrations: (*a*) There is an embarrassment of living creatures in many country places. The author's plan is to make sure of the commonest—let us say, a score of the butterflies, birds, or trees. (*b*) There are many subjects which are so little understood that the cautious teacher is often inclined to leave them alone. The author's advice is rather to tackle them, to confess them as unsolved problems, and to leave them as seeds in the mind. We refer to such subjects as the migration of birds. (*c*) The author is not afraid of sounding the note of wonder. "To watch the germination of an inert seed, the development therefrom of the tiny plant, the growth of bursting bud and flower, is to cross the threshold of Nature's impenetrable mysteries." He quotes the sentence: "The love of a flower in the heart of a child is the highest thing that Nature-study can hope to develop." But the suggestion of this mood is not inconsistent with learning quite precisely how to graft or with understanding the work of Mendel or of Pasteur. We are sure that teachers of Nature-study will find Mr. Downing's book very profitable, and they ought also to know his almost perfect introduction to heredity, "The Third and Fourth Generation."

VACCINE-THERAPY.

Practical Vaccine Treatment for the General Practitioner. By Dr. R. W. Allen. Pp. xii + 308. (London: H. K. Lewis and Co., Ltd., 1919.) Price 7*s.* 6*d.* net.

THE author of this little work is well known as an enthusiastic advocate of vaccine-therapy, on which subject he has already written widely. In the present volume he addresses himself more particularly to the general practitioner, for whose benefit and guidance he explains in lucid and forcible terms his methods and practice. The one theme which runs through the whole volume, and colours his frequent comments on the experience and teaching of other vaccinists, is his insistence on the necessity for adequate dosage capable of exciting focal or general reactions and its control by the closest observation of the patient's responses and clinical symptoms. He asks his readers to follow his methods and thereby assist vaccine-therapy "to take its rightful position as the most truly scientific therapeutic agent in the doctor's armamentarium." Unfortunately, however, the book contains scarcely one pessimistic note, and, again, the unbiassed reader, who otherwise wishes vaccine-therapy well, is left with the reflection that, so long as the results of vaccine-therapy continue to be assessed by the unscientifically accumulated personal impressions of vaccinists, so long will vaccine-therapy continue to hold no higher position than that of an empirical remedy, in spite of its undoubted scientific basis.

On this point the author, referring to vaccine treatment in respiratory diseases, remarks: "No physician has the right to play about with cases of pneumonia to satisfy statisticians or opponents of vaccine treatment. It thus becomes necessary to rely on the clinical impressions of reliable observers." Such impressions, we believe, carry less and less weight when we come to evaluate

the results of specific therapy in its widest sense, and it is not unlikely that, as our knowledge of the non-specific as well as the specific therapeutic effects arising from the introduction into the animal body of a bacterial protein accumulates, many of the deductions so glibly drawn by ardent vaccinists may go by the board. None the less, as an exposition of the faith of an enthusiastic and somewhat over-confident vaccinist, the book is well worthy of perusal, and contains what, on the whole, appears to be sound advice.

The early chapters are devoted to general questions connected with the nature, preparation, and administration of vaccines, and are excellently written. For the chapter dealing with the best methods for securing material from various sources for culture and preparation of vaccine, the reviewer has nothing but praise, the laudable object being to secure "the right kind of material in the right kind of way." Chapters follow on the use of vaccines in prophylaxis and in the treatment of the carrier-state, but the greater part of the book is devoted to vaccines as therapeutic agents in practically every microbic disease. There would appear to be no microbic disease, whether of acute or chronic character, which is not amenable to vaccine-therapy when employed in the manner indicated by the author.

OUR BOOKSHELF.

The Stars Night by Night: Being the Journal of a Star Gazer. By J. H. Elgie. (First published as "Night Skies of a Year," 1910.) Pp. xiv + 247. (London: C. Arthur Pearson, Ltd., 1919.) Price 1*s.* 6*d.* net.

THERE are many ways of being an astronomer, of which perhaps the easiest is to learn the stars and know them by position and name—and there are grades even in that. We do not imply that this defines Mr. Elgie's limitations, but he has written a very pleasant and useful book to help others to attain this degree of astronomical knowledge. Of such books there are many, but this is somewhat unusual. Written in a chatty manner on the model of White's "Selborne," it describes the author's experiences as a star-gazer or naked-eye observer throughout a year, with much quotation, anecdote, and general astronomical information intermingled. There are more than a hundred diagrams, showing the constellations as they appear with reference to the horizon at different dates. Naturally, the diagrams apply to any and all years, so the year when the observations were made is not given, except incidentally in the index, but the fact that the author saw Mira Ceti at maximum early in January, and that it was then as bright as γ Cygni, is fairly conclusive evidence that it was 1907.

The book is a cheap reprint of an earlier one published in 1910, "The Night Skies of the Year," which still remains as the page-heading, and it is not surprising that this reprint should have been considered advisable. It should command a large sale, for both the general reader and the astronomer of any category will find something of interest in its pages.

The Examination of Milk for Public Health Purposes. By Joseph Race. Pp. vi + 224. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1918.) Price 8*s.* 6*d.* net.

THIS book gives a very useful summary of the chemistry and bacteriology of milk. The chemical portion includes the composition of milk and the chemistry of the various constituents, enzymes, immune bodies, mineral salts, etc., with details for their detection and estimation. Milk standards are considered, as well as preservatives. In the bacteriological portion a general account is given of the bacteria of milk and of methods for their enumeration. Chapters are devoted to excremental organisms and to streptococci, to the tubercle bacillus and other pathogenic organisms which may occur in milk, to cells, dirt, débris, etc. Chap. ix. deals with pasteurised milk and aciduric bacilli; and directions for the preparation of culture media and tables of specific gravity, for the conversion of cuprous oxide and copper to lactose, etc., are given in an appendix. The descriptions throughout are clear and concise, and the analytical methods are clearly set out. The book, which contains within its compass an extraordinary amount of information, is most useful, and can be strongly recommended as a laboratory handbook for the teacher and student.

R. T. H.

Insect Pests and Plant Diseases in the Vegetable and Fruit Garden. By F. Martin Duncan. Pp. 95 + 12 plates. (London: Constable and Co., Ltd., 1919.) Price 3*s.* 6*d.* net.

THE object of this little volume is to provide gardeners and allotment-holders with a simple account of the commoner insect and fungoid pests. The descriptions of the various harmful species appear to be on the whole trustworthy, and some approved methods for eradicating them are recommended. But the book's value is diminished by want of revision in the light of modern work. For example, the author is content with Curtis's determination of the potato aphid, and states that the larva of *Anthomyia radicum* is a common pest on cabbage roots, which, despite the name of the fly, is not the case. The account of the infection of potato by Phytophthora and the denial of sexual reproduction in this fungus also require modification. The seven orders (including the comprehensive "Neuroptera" of old-time entomology) into which insects are said in the introduction to be "generally grouped" would not be accepted as an adequate systematic arrangement by any student of to-day. The illustrations include some good photographs and some indifferently executed drawings.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Deflection of Light during a Solar Eclipse.

IN discussing the effects of atmospheric refraction during solar eclipses Prof. Anderson disregards the shallowness of the effective layer of air as compared with the diameter of the moon's shadow. Unless the sun be very near the horizon, a line of sight drawn from the centre of the umbra to a point in the corona will remain within the umbra right through this layer. This consideration vitiates the method of solution adopted by Prof. Anderson, and consequently its results. On reading his first letter (NATURE, December 4, 1919) I was struck by the ingenuity of his explanation, more especially as I believe he undervalued the amount of the angular deviation arrived at on his theory through taking the sun's radius to be half, instead of a quarter of, a degree. In view of the importance of the subject, a fuller investigation seemed to be required. I hope soon to publish a note giving the complete solution of the problem, and may therefore confine myself here to a statement of the result, which is quite fatal to Prof. Anderson's explanation. I take the altitude of the sun to be 45° and the maximum fall of temperature 4°; the figures given may easily be modified to suit other conditions. I further assume the most favourable distribution of temperature, which is that adopted by Prof. Anderson, when the line of maximum fall of temperature is parallel to the edges of the moon's shadow and independent of altitude. Two stars at a distance of three solar diameters from each other might then show an increase in apparent distance owing to refraction amounting to the 240,000th part of a second of arc. If the diminution of the temperature effect with altitude be taken into account, this figure should be divided by 4.

ARTHUR SCHUSTER.

The Magnetic Storm of August 11–12, 1919.

THE principal question raised by Mr. Evershed in NATURE of January 1, viz. the simultaneity of S.C.s (sudden commencements of magnetic storms) at different parts of the globe, has already a considerable literature. It has been discussed by Prof. S. Chapman and myself in the Proceedings of the Physical Society (vol. xxx., p. 205; vol. xxvi., p. 137; and vol. xxiii., p. 49). It scarcely admits, perhaps, of a precise answer. S.C.s vary from one part of the earth to another, not merely in size, but also in type. In India, for instance, they are normally unidirectional, and much larger in H (horizontal force) than in the other elements. At Kew, and still more at Eskdalemuir, they are often oscillatory, the main movement, a rise in H, being preceded by a shorter and smaller fall. In the Antarctic (Scott's stations) they seem to be always oscillatory and of similar magnitude in the different elements. The time when a movement becomes visible depends on its size and the sensitiveness of the magnetograph. Magnetographs differ widely in sensitiveness and vary in type. An oscillatory movement that is very small or of very short period cannot be recorded by an ordinary magnetograph.

Whether the time of the S.C. is affected by the meridian position of the sun, *i.e.* by the local time, has been discussed by Prof. Chapman. Whether the results he got implied any real difference is a matter of opinion, but if any difference existed it was a question, not of minutes, but of seconds. If any difference existed in the times, one would expect it to be at least as conspicuous in the amplitudes. As I have lately shown, the *type* of the S.C. recorded in the Antarctic does seem to depend on the local time. Eleven S.C.s which occurred between 11h. 59m. and 17h. 20m. G.M.T. agreed in type; while six which occurred between 21h. 3m. and 23h. 25m. also agreed in type; but the two types were fundamentally different. The first class represent noon and the earlier afternoon at Eskdalemuir, but midnight or early morning in the Antarctic; while the second class represent hours near noon in the Antarctic. Complete measurements of the horizontal amplitudes of the S.C. movements exist for eight of the first and three of the second class. Dividing the sum of the Eskdalemuir movements by the corresponding Antarctic sum, we get 0·43 for the first class and 0·42 for the second, the mean from all the S.C.s of which I have complete records at both stations during 1911–12 being 0·42. The values of the ratio vary greatly for individual S.C.s, so that the coincidence in the above figures must be largely accidental. But, at all events, it seems incompatible with any conspicuous influence of local time on the amplitude.

As to the particular S.C. of August 11–12, 1919, when first measuring the Kew curves I made the time slightly before 7h. G.M.T., whether one or two minutes before I now forget. Remeasuring it now, with as little prejudice as possible, I make the time 6h. 58m., agreeing with the value got by Dr. Crichton Mitchell for Eskdalemuir. The time-breaks at Eskdalemuir occur on the curve itself, so the estimate there is free from the uncertainty to which, I presume, Mr. Evershed refers, which is usually known as "parallax" between the curve and time lines. This source of uncertainty is also practically non-existent at Kew, but the train and tram disturbances now experienced there make all measurements less certain than they used to be. The S.C. on August 11 was, however, so large, and the discontinuity in the H curve so conspicuous, that I think the uncertainty might fairly be put at ±0·5 minute. The uncertainty of the ordinary measurement at the average observatory, even for S.C.s, is certainly not less than this, and is probably a good deal larger.

C. CHREE.

Relativity and Radio-activity.

WITH regard to some of the postulates of relativity, it seems interesting to ask if radio-active instability might not be capable of providing a timekeeper which would retain its uniformity independently of motion relative to the æther.

As to how such a clock might be made practical or whether it must remain theoretical is beside the present question. So also is the degree of accuracy which might be attainable. Primarily, we might suppose the radio-active clocks rated one with another by a simple count of the α-rays emitted over a certain solid angle and during a certain time interval, the clocks being in the one locality. Thereafter these clocks would serve to define simultaneity in widely separated localities, the diminishing quantity of the radio-active substance notwithstanding.

As I say, the primary question is not so much one of practical application, but as to whether it would be theoretically possible in this way to observe motion relative to the æther.

Or is radio-activity also "in the conspiracy"?

J. JOLY.

Trinity College, Dublin.

British Botanic Gardens and Stations.

IN the article on British botanic gardens and stations in the jubilee number of NATURE (p. 263) the statement is made that by the middle of the eighteenth century, when Kew and the Botanic Garden at St. Vincent were founded, "the purpose of botanical collections had become largely limited to the assemblage of plants interesting because of their rarity. Presently a healthy reaction against this rather narrow outlook arose . . .," and the example is quoted of the Calcutta Garden, founded in 1786 for the purpose, not of collecting rare plants as articles of curiosity, etc., "but for establishing a stock for disseminating such articles as may prove beneficial to the inhabitants, as well as to the natives of Great Britain, and which ultimately may tend to the extension of the national commerce and riches." Your contributor appears to have overlooked the fact that a very similar purpose underlay the founding of the St. Vincent Garden, as shown by the advertisement which appeared in the Transactions of the Society of Arts for 1762, offering a reward "to anyone who would cutivate a spot in the West Indies in which plants useful as medicine and profitable as articles of commerce might be propagated, and where nurseries of the valuable productions of Asia and other distant parts might be formed for the benefit of his Majesty's Colonies."

I am glad to add that the Royal Botanic Gardens, Trinidad, attained its centenary this year.

W. E. FREEMAN,
Director of Agriculture.

St. Clair Experiment Station, Port-of-Spain,
December 6.

I AM very grateful to Dr. Freeman for having directed attention to the existence of this interesting documentary evidence that West Indian public opinion in 1762 was a quarter of a century in advance of official opinion in the East Indies. This conclusion is pointed to by the circumstance that there was a demand in the West Indies for such sumptuous works as "The Natural History of Barbados," by Griffith Hughes, published in 1750; "The Natural History of Carolina, Florida, and the Bahamas," written by Mark Catesby, revised after Catesby's death by G. Edwards, and published in 1754; and "The Natural History of Jamaica," by Patrick Browne, published in 1756, of which a second edition was called for in 1789. It is important to have this conclusion definitely confirmed.

THE WRITER OF THE ARTICLE.

NATURAL HISTORY OF SOUTH AFRICA.[1]

MR. FITZSIMONS'S volumes are not strictly zoological treatises. They are intended to supply information about the ways and habits of the creatures of veld, forest, mountain, and stream. It sounds somewhat strange to hear mammals referred to as belonging to the "lower animal kingdom." The author speaks sometimes of "animals and birds"; in other places he alludes to "birds and mammals," while the bats are spoken of as "flying mammals." Since this work is addressed to school teachers, senior pupils, and the general public, it would have been better to explain what is meant by "mammals" and retain the term throughout. Mr. Fitzsimons holds the view that the leopards in wild countries uninhabited by man "are still fulfilling the mission for which the Creator evolved them" (i., p. 120), and that "it is essential that the old, decrepit, or malformed animals should not be allowed to live and breed, otherwise the great plan of the Creator in perfecting the various forms of life would be marred" (ii., p. 79).

These and other views may not be acceptable to the modern zoologist, but there can be no doubt about the importance and interest of these two volumes to all lovers of natural history, and particularly to those who keep monkeys and other mammals as pets and to the guardians of our Zoological Gardens. A charm of style and a freedom from errors distinguish the volumes. The vivid descriptions of the habits of the blue ape and the Chacma baboon, as well as of those of

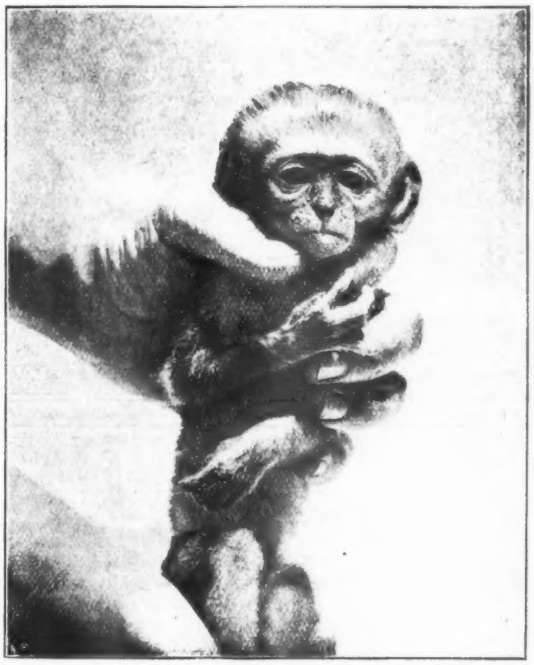

FIG. 1.—A baby Vervet monkey, born at the Port Elizabeth Museum. From "The Natural History of South Africa."

many other species, are fascinating to read. The author gives us further particulars of the wonderful story we heard long ago of "Jack," the Chacma which acted as signalman on a South African railway line. When his master, to whom he was devotedly attached, became incapacitated, owing to an injury, "Jack" took over his duties. He worked even the levers on the line by himself (i., pp. 61–67), and finally pushed his master home every night on a little railway truck. This marvellous story is fully substantiated by creditable witnesses.

Mr. Fitzsimons had a serval which was as tame as any domestic cat, and even when full-grown it did not lose any of its playfulness, and

[1] "The Natural History of South Africa." By F. W. Fitzsimons. "Mammals." In four volumes. Vol. i., pp. xix+178; Vol. ii., pp. xi+195. (London: Longmans, Green, and Co., 1919.) Price 9s. each vol.

nothing gave it keener joy than to be romped and played with. It had, however, to be kept in partial confinement on account of its fondness for poultry. The author makes some appropriate remarks on the subject of keeping animals in confinement.

Some people consider it distinctly cruel to deprive animals of their liberty, although they may be confined in large, roomy, comfortable cages and all their physical needs provided for. Such folk know little or nothing of the hardships which most animals in their native haunts are called upon to undergo in the shape of scarcity of food, inclement weather, and the necessity to be at all times on their guard against the many enemies by which they are surrounded. The feelings of the lower animals cannot be gauged by those of us who have the mental, moral, and spiritual faculties and an advanced condition of development. If the physical needs of the lower animals, and even the primitive races of man, are provided for, they are then in a condition of perfect happiness.

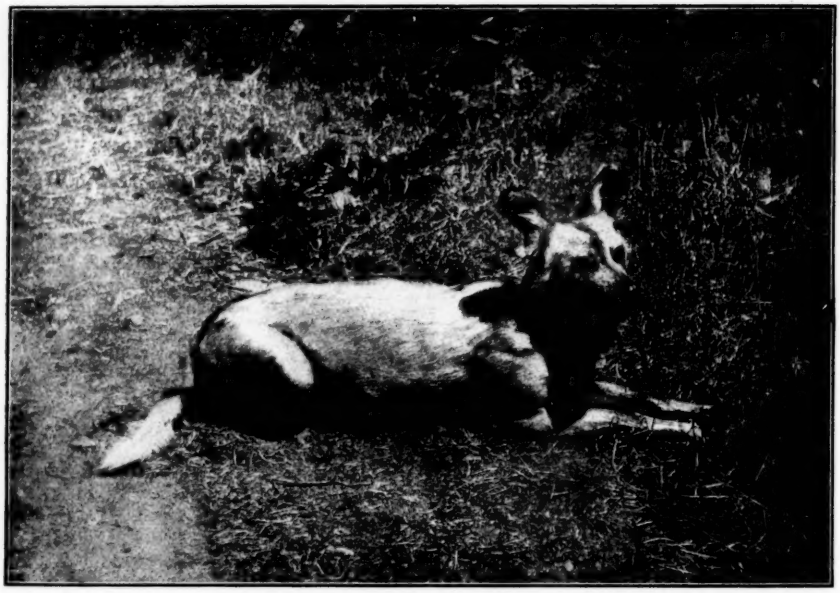

FIG. 2.—The Cape Hunting Dog, which is as big as a mastiff. From "The Natural History of South Africa."

No one would imagine that lions could live on vegetables, and yet the late Dr. Livingstone pointed out that the lion of Central Africa frequently feeds on the desert water-melon. Mr. Fitzsimons is wrong in his statement that the lioness produces no more than five young at a birth (i., p. 123). On several occasions a lioness in the Dublin Zoological Gardens had a litter of six cubs.

There seems to be evidence to show that the African wild cat breeds freely with the domestic cat, and this would strengthen the view that the former is the ancestor of the European domestic cat.

The two volumes which have been issued contain a most valuable store of information on the habits of wild mammals. It is interesting to note that the aardwolf lives almost entirely on termites; that the Cape hunting dog will scour the country for days, doing perchance more than 100 miles a day, on a perfectly empty stomach; and that the Cape otter seems to be slowly abandoning its aquatic habits. Some mammals, like the ratel, exhibit an unusual amount of intelligence, if the reports can be credited that it follows the movements of a little bird known as the honey guide in its search for honey. "Of all the animals known to me," says the author, "the ratel has the most energy, endurance, and perseverance."

Many of the illustrations are of a high standard, and add to the value of this welcome work.

INDUSTRIAL RESEARCH.[1]

DURING the past few years manufacturers have tended to lift the veil of secrecy behind which they were wont to hide their works processes and operations. Under the menace of war, and with the partial removal of ordinary inter-competitive conditions, rival manufacturers who were faced with problems incident to the fabrication of new war products turned to each other for mutual guidance and assistance, and a very considerable interchange of knowledge and experience resulted, to the benefit of all concerned. The tendency to secrecy, which prevented manufacturers from sharing their knowledge for the common benefit of the industry and for the better combating of foreign competition, was one of the

[1] Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1918-19. Pp. 94. (London: His Majesty's Stationery Office, 1919.) Price 6*d.* net.

greatest obstacles in the way of organising industrial research on a scale and of a character requisite for the needs of industry as a whole. It is therefore most interesting to note, from the recently published report of the Department of Scientific and Industrial Research, what success has attended the efforts to establish research associations. These associations are organised and supported by manufacturers in specific industries, and some financial aid is granted by the Department for a limited period of time, of an amount about equal to that contributed annually by the firms comprising the associations.

Through such means research bearing on problems of common interest in the several industries may effectively be carried out, and those channels for the interchange of knowledge and experience with which we have become familiar during the war, and which are so essential if the greatest benefits are to be obtained, will be maintained.

Already a number of the most important industries have established research associations, and most of the remainder are giving this matter earnest consideration. Some question might be raised on the soundness of the policy of conducting research in this manner, whereby each industry is more or less self-contained, so that difficulties arise in the ready interchange of special knowledge which, though acquired in the first instance by and for one special industry, would be, if readily available, of the very greatest interest and value in others. One might anticipate, however, that the present type of organisation will be only a step towards an ultimate goal, possibly a centralised scheme which will effectively provide for that interchange of thought and knowledge between research workers without which the whole benefit of their knowledge and discoveries cannot be secured.

The widespread variety of researches coming under the survey of the Department is worthy of note; of these, none is of greater importance than that relating to medical work. Jointly with the Medical Research Committee, the Industrial Fatigue Research Board has been established, in order to carry out investigations in industry concerned with output, timekeeping, labour, wastage, and such data as will serve as indices of fatigue. The enormous waste of human effort arising from inefficient application in almost every kind of mental and manual operation has long been recognised. Much of this inefficiency has been due to a lack of knowledge of the fundamental conditions governing fatigue, and at this time there is no investigation of greater importance than that which concerns the conservation of human effort, especially having regard to the far-reaching effects of fatigue, manifested in ill-health, increased risk of accidents, and loss of production. The results of researches falling within the scope of the Industrial Research Board may prove of outstanding value, not only as affording a scientific basis for the determination of the real working capacity of individuals, but also as indicating the laws underlying the most economical application of human effort, the observance of which will reduce to a minimum all the physiological and psychological reactions arising from fatigue, which are such potent factors in the cause of industrial discord and unrest.

It is gratifying to note the increased attention given by the Department to the financial assistance of those students who desire to qualify for research work. The lack of sufficient numbers of really sound research workers is acutely felt in industry, and money expended in bringing to maturity the powers of young men who exhibit an inherent capacity for scientific investigation will be wisely spent.

A further interesting feature of the report is the organisation of means for co-operating with the extensive scientific investigation that is being conducted by research organisations in the overseas Dominions. It is not sufficiently realised by consumers in this country that it is just as important for research to be conducted towards the efficient production of raw material as towards cheapening the more advanced processes of manufacture. In this connection every encouragement should be given to maintaining the closest possible relation with research in the Colonies.

A matter to which one would like to see greater attention given is a means for developing and maintaining an acute interest in scientific research on the part of the manual workers in industry and by the general public. As the report truly points out, a marked change is taking place in the attitude in industry towards scientific research, but this attitude has largely been the result of scientific achievement during the war, and unless efforts are made to stimulate and maintain it this interest is likely to suffer eclipse as other problems arise. Probably no better means could be devised for achieving this purpose than such displays as the admirably conducted British Scientific Products Exhibitions of the last two years, coupled with systematic propaganda in the daily and technical Press.

A. P. M. FLEMING.

SERICULTURE IN INDIA.[1]

FOR long past, the decline of the Indian silk industry has given rise to considerable anxiety. The main feature of the situation has been a serious falling off in the production of raw silk in Bengal (hitherto the principal silk-producing province of India) involving a restricted use of Bengal silk in India itself and a great decline in the overseas exports of raw silk. The place of these exports has in part been taken by the excellent silk now produced in Kashmir, but the quantity is small compared with the Bengal exports of former years. The unfortunate result has been a great advance in the import into India

[1] Report on an Inquiry into the Silk Industry in India. By H. Maxwell-Lefroy and E. C. Ansorge. Vol. i., "The Silk Industry." By H. Maxwell-Lefroy. (1916.) Pp. ii+211. Price Rs. 2, or 3*s*. Vol. ii., "Present Condition of the Silk Trade of India." By E. C. Ansorge. (1916.) Pp. vi+115. Price Rs. 1 As. 6, or 2*s*. Vol. iii., Appendices to Vol. i. By H. Maxwell-Lefroy. (1916.) Pp. 227. (Calcutta: Superintendent Government Printing, India, 1917.) Price Rs. 2 As. 12, or 4*s*. 2*d*.

of raw silk from foreign countries (especially Japan), and, more unfortunate still, a startling increase in the import of manufactured silk piece goods, also from Japan. When it is added that, with notable exceptions, the Indian raw silk is so defective as regards reeling and other characters as to hold but a low place in the estimation of manufacturers, it will be evident that the position of the Indian silk industry is indeed serious.

With the view of ascertaining whether, and by what methods, the revival of the industry is possible, the Government of India in 1915 decided upon a comprehensive survey of the whole question in both its sericultural and industrial aspects. Prof. Maxwell-Lefroy and Mr. C. E. Ansorge were appointed to conduct this inquiry, and their exhaustive reports are now available. Prof. Lefroy's inquiry was mainly concerned with sericultural and technical questions, while Mr. Ansorge's investigations have provided an admirable account of the industrial aspect of the industry.

India possesses great advantages as a silk-producing country. The enormous areas suited to the worms and their food-plants (in addition to the cultivated mulberry silk she has at least one promising "wild" silk), the abundance of cheap labour, the local market, and, not least, an experience extending over many centuries, should place India in the forefront of the silk countries of the world. Her present unfortunate position (resulting mainly from the decline in the Bengal production) is ascribed by Prof. Lefroy to four main causes, viz., (1) the increased production of silk in Japan, (2) disease among the worms, (3) increased value of other crops, (4) the inferiority of the Bengal worm. We suspect that (2) and (4) are the fundamental causes of the existing state of affairs. With expert organisation, the compulsory and exclusive use of disease-free seed and the improvement or replacement of inferior races of worm would unquestionably result in the relative rise in value of silk as a crop, and enable the competition of Japan to be more successfully met. Unmistakable object-lessons are afforded by the results of the scientific management of the industry in the native States of Kashmir and Patiala, both of which now produce an excellent mulberry silk.

These facts are recognised by Prof. Lefroy in making his recommendations. His principal suggestion is for the establishment of a central silk institute to investigate all branches of sericulture with a view to improvement; to study processes of weaving, dyeing, and finishing; and to afford expert advice on all phases of the industry, including the questions of trade and possible new markets.

It is possible that the results of Prof. Lefroy's investigations may not be regarded officially as indicating a clear case for a strong forward silk policy in India. The fact that the decline in silk is in part attributed to the increased value of the other crops will naturally result in hesitation to embark on a large development of sericulture absorbing an amount of energy which conceivably might be more profitably utilised in other directions. It must not be overlooked, however, that silk-raising can be successfully carried on only as a cottage industry, and that without deflecting a single worker from any other crop scientific organisation and control of the present sericultural industry would add enormously to the quantity and quality of the output of raw silk. The question is, however, admittedly difficult. Unfortunately, the fact is that for a large part of India's requirements the quality of the local silk is "good enough," and there may be a disposition to leave it at that. In doing so, exceptional opportunities —commercial, industrial, imperial—will be ignored. With the measures suggested by Prof. Lefroy (notably the establishment of a silk institute), India should be able to replace with locally-produced silk much of the raw material imported from Japan, and enable the growing import of silk fabrics to be reduced. As regards the overseas export of raw silk, India would find markets ready to take all the silk she could spare so long as it conformed to accepted standards of quality, reeling, and cleanliness. Within the last few years there has been a remarkable development in the world's consumption of silk (especially in America), and manufacturers would welcome with open arms new sources of supply of the raw material. The situation offers unique opportunities for India to establish her position as an Imperial source of merchantable raw silk; and before finally deciding as to the future silk policy of the country the authorities would be well advised to consider the changes that are taking place in the economic conditions of the world's silk trade.

SIR WILLIAM OSLER, BART., F.R.S.

ACLAND, Burdon Sanderson, Osler; and if to these we add—in a chair closely allied to theirs—George Rolleston, we look upon a procession of men of rare distinction of character and accomplishments; and each in his very distinction different from the others. Of such children Oxford may well be proud. For if Osler by birth was a Canadian, and in much of his life American, yet his temper and culture were also of the best Oxford could give; Oxford whose gifts are lavished abroad far beyond the narrow limits of her own walls. Thus Osler, "after a sleep and a forgetting," and "trailing clouds of glory" from the old West Country of his fathers, came to Oxford as to a spiritual home. And Oxford took him to her heart as her own; there, as one of her own, he rested; but bringing with him, as gifts from the New World, an openness and simplicity of mind and conversation, a frankness and generosity of temper, a freedom from the frost and weight of custom, and a pioneer's command of affairs which made him as delightful a fellow-worker as he was clear-sighted and effectual. Children loved him, for in him they found the best part of themselves. Osler happened to be

visiting in Oxford with the present writer when Sanderson intimated his intention to retire from his chair; a few hours later, after some hints from his friends, Osler felt the call of the bounteous mother; and not the least of the warrants of his qualities was in this, that his friends in Oxford almost sprang upon him, as they realised that before them they had a man worthy to succeed his honoured predecessors.

And if Osler had not also to capture Great Britain, as he captured Oxford, it was because Great Britain was already his mistress. Indeed, there was not a school of medicine in the Old World where his presence was not almost as well known, and his friendship as precious, as in the New. It was characteristic of him that a few years later he obtained leave from Oxford to spend some months in Paris, during which period he regularly attended the clinics of the great hospitals, at 7.30 a.m., like an ordinary student.

Of Osler's contributions to knowledge it is as hard to make a list as it would be for Socrates. They were many, no doubt, but consisted even more in his insemination of other minds, in personal teaching and influence upon his disciples. His great text-book, for many years, and still, the guide of every English-speaking student, had many and almost singular merits. Although within its compass no particular subject could be dealt with at large—for every subject had to be kept in subordination to the whole—yet in the successive editions it was always helpful in any quest to turn to "Osler," because, if it were but in a word, or the turn of a sentence, one perceived that the latest and best researches, if not presented in detail, were known to the author. Thus the work was not a provider only, but also to the wise an indicator. The reader feels as he reads that both whole and parts were being continually re-adapted to the developing phases of knowledge. Perhaps the author's most original and valuable researches were in the field of the diseases of the spleen and blood; but he made eminent contributions also to the study of infections of the heart, of angina pectoris, of malaria, and of many minor maladies. But, the most modest of men, his conversation was always of the good work of others, silent on his own. It is to be hoped that some one of his pupils will prepare a bibliographical list of his essays and papers, and, furthermore, of his literary essays, such as are contained in the delightful volume entitled "Æquanimitas." It is said that a great part of the revision of the text-book for the new edition, on which he was at work, is written.

Osler's work for others was so incessant, and his hospitality so unbounded, that one always wondered when and where he amassed and made use of his learning; learning which, in particular, would discover itself, as it were, by accident, unless, indeed, his companions were expert enough to see it under the surface of his talk. Somehow or other he was not only in sympathy with various subjects of study other than medicine, especially with literary pursuits, but was able also to converse on something like equal terms with the masters of them. When in Cambridge, he found himself thus quite at home with Aldis Wright in the literature of the seventeenth century; and his proficiency in the history of medicine, well known to all students of the subject, gave breadth and living interest to all his teaching. His apprehension must have been as quick as his memory was tenacious and orderly and his power of expression felicitous. His address last year to the Classical Association was as sparkling as it was profoundly humane; eminent for the depth of its sympathies and for the compass of its understanding, it was no *tour de force*; the speaker made no pretence to technical scholarship, his discourse had a more free air, was more of the world, more comprehensive than is common with such addresses, but yet on its own ground was a brilliant oration.

A quality that made Osler so fascinating a companion, his teaching so vivid and telling, and his parts in debate often so lively, was his wit and humour; the sharpness of the wit tempered by the sweetness of the humour. Indeed, much of his playfulness and whimsical mystifications were, in naturalist's phrase, a protective colouring to cover deep sensibilities. In its *finesse* his conversation resembled that of Henry Sidgwick; not a more or less laboured deliverance of epigrams, but a light, nimble play of insight and fun. Much of its piquancy lay in the half-concealment of the treasures of the mind.

It is a touching thought that with all these attainments, all these accomplishments, we are mourning at this moment, not, or not merely, the skilful doctor, the great scholar, the research student, or even the wise and tactful reformer, but far more the sympathetic friend of all and of a few; one in whom this expansion of his friendship made him none the less a dear brother to those who were nearest to him.

The loss of his one child, an undergraduate of Oxford who was killed in action, smote Osler to the heart. His son had inherited his father's abilities and character, and shared his literary tastes and his pride in the fine library which had been always the library *Gulielmi Osler et amicorum*. This blow to him and Lady Osler was beyond healing; but last summer, during some fine weeks in Guernsey, he regained much bodily health. A fine swimmer, he drew life from the sea. Unhappily, a little later he was caught by the ruthlessly sudden strike of the railwaymen, and had to travel in an open motor-car from Newcastle to Oxford. He reached home chilled and weary, and was attacked by a broncho-pneumonia, which, after many phases and some transient signs of amendment, ended rather unexpectedly in death on December 29. Two days before had arrived in Oxford the "Festschrift," compiled by his friends for his seventieth birthday. This volume, which had been presented in form but delayed in completion, he was never to see; it is now a monument, one among many, to his memory.

C. A.

NOTES.

THE list of New Year Honours includes one earl, three barons, seven Privy Councillors and three in Ireland, nineteen baronets, and a number of appointments to orders of knighthood. Sir Bertrand Dawson, Physician in Ordinary to the King, and Dean of the medical faculty of the University of London, is one of the new peers. Among the new knights are Prof. Arthur Schuster; Dr. E. A. Wallis Budge, Keeper of Egyptian and Assyrian Antiquities, British Museum; Col. W. A. Churchman, Ministry of Munitions Explosives Department; Dr. J. Court, known by his researches on diseases of miners; Mr. F. C. Danson, chairman of the Liverpool School of Tropical Medicine; Mr. D. E. Hutchins, for his services to forestry; Mr. James Kemnal, for public services in connection with the manufacture of munitions; Mr. F. S. Lister, research bacteriologist, South African Institute for Medical Research; Mr. H. J. Mackinder, M.P.; and Dr. F. G. Ogilvie, Director of the Science Museum, South Kensington. Prof. S. J. Chapman, Joint Permanent Secretary, Board of Trade, and Sir Richard Glazebrook have been promoted from C.B. to K.C.B. Dr. G. R. Parkin has been promoted to the rank of K.C.M.G., and Mr. H. N. Thompson, Chief Conservator of Forests, Nigeria, has received the honour of C.M.G.

WE regret to announce the death on January 4, at seventy-eight years of age, of Sir Thomas R. Fraser, F.R.S., emeritus professor of materia medica, University of Edinburgh, and Honorary Physician-in-Ordinary to H.M. the King in Scotland.

THE PRINCE OF WALES, who has recently become vice-patron of the Royal Geographical Society, will be present at the meeting of the society on Monday, February 2, at the Central Hall, Westminster, at 8.30 p.m., when a paper will be read by Major-Gen. Sir Frederick Sykes on "Air Routes of the Empire."

THE *Times* correspondent at New York reports that violent earthquake shocks were felt over the greater part of the Mexican Republic on Saturday night and Sunday, January 3–4. The State of Vera Cruz seems to have suffered most. The Mexican Government Observatory places the centre of the disturbance near the volcano of Orizaba. A shock was recorded by the seismograph at Kew Observatory at 5.25 a.m. on January 4.

ON Tuesday next, January 13, at 3 o'clock, Sir John Cadman will deliver the first of two lectures at the Royal Institution on (1) "Modern Development of the Miner's Safety Lamp," and (2) "Petroleum and the War." The Friday evening discourse on January 16, at 9 o'clock, will be delivered by Sir James Dewar on "Low-temperature Studies," and on January 23 by the Hon. Sir Charles Parsons on "Researches at High Pressures and Temperatures."

THE Ramsay Memorial Fund has received from Prof. H. Kamerlingh Onnes a very substantial contribution of 1571*l.* 9*s.* 5*d.*, which has been given or promised by donors in Holland. These generous contributions are evidence of the sympathy felt in Holland for British science and scientific workers, and the respect so widely felt in that country for the memory of the late Sir William Ramsay. Among the subscriptions are:—Philips Gloeslampenfabriek, 500*l.*; Fransch Hollandsche Oliefabrieken, Delft, 300*l.*; Nederlandsche Gist & Spiritusfabriek, Delft, 300*l.*; Van den Bergh's Fabrieken, Rotterdam, 300*l.*; and Lym & Gelatinefabriek, Delft, 100*l.*

ANNOUNCEMENT is made in the *British Medical Journal* that the eighty-eighth annual meeting of the British Medical Association will be held at Cambridge next summer, under the presidency of Sir Clifford Allbutt, Regius professor of physic in the University, who will deliver his address on the evening of Tuesday, June 29. The sectional meetings for scientific and clinical work will be held on June 30, July 1, and July 2, the mornings being given up to discussions, and the afternoons to clinical and laboratory demonstrations. There will be twelve sessions, of which five will meet on each of the three days, and the remainder each on one day. The annual representative meeting will begin on June 25. The annual dinner has been fixed for July 1, and on the evening of July 2 Dr. G. S. Graham-Smith will give the popular lecture. Saturday, July 3, the last day of the meeting, has been set apart for excursions to places of interest in the neighbourhood.

FURTHER excavations at the well-known Anglo-Saxon site of Ravensbury Manor, Mitcham, have brought to light numerous remains of the period. The old gravel-pit is being extended, and further relics will no doubt be found. Six graves have so far been opened up, with the bones of two giant chieftains and a cripple with a diseased thigh-bone. Two swords, a bronze buckle, and an earthenware jar have been found. At earlier excavations no fewer than a hundred skeletons were exhumed. The first discovery was made in 1848, and in 1895 the opening-up of a new gravel-pit by Mr. G. P. Bidder brought to light a quantity of objects. Later digging by Col. H. F. Bidder produced knives, spear-heads, a few swords, pottery, shield-bosses, saucer-shaped brooches, and some beads, whilst a number of female skeletons were found to have been thrown carelessly into the graves of the men. One grave contained a coin of Constantius II., and Mr. Reginald Smith was of opinion that the date of the cemetery was the first half of the fifth century. Great care will, it is understood, be taken to preserve anything of value that comes to light, but at present nothing new has been found.

THE annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 6 and 7, at the Institution of Civil Engineers, Great George Street, London, S.W.1. The retiring president, Mr. Eugene Schneider, will induct into the chair Dr. J. E. Stead, the new president-elect. The council is prepared to consider applications for grants from the Carnegie Fund in aid of research work, of such value as may appear expedient, but usually of the value of 100*l.* in any one year. The awards are made irrespective of sex or nationality. Special forms, on which candidates should apply before the end of

February, can be obtained from the secretary of the institute. The research work must be on some subject of practical importance relating to the metallurgy of iron and steel and allied subjects. The results of research work must be communicated to the institute in the form of a report. By the invitation of the retiring president, Mr. Eugene Schneider, arrangements are in progress for holding the autumn meeting in France next September, provided no unforeseen contingency occurs. Early notice will be given of the precise date and place of meeting and the localities which will be visited.

WE note with much satisfaction that the Government of New Zealand has extended the absolute protection of seals in the area under its control for a period of three years, and that the Prime Minister of Tasmania has decided not to renew the lease of Macquarie Island to the company which so mercilessly exploited the wild life over which it had obtained control. Quite apart from the hideousness of the methods of slaughter, this protection has barely come in time to save these creatures from extermination. Although this danger has, time and again, been pointed out, the authorities allowed commercial interests to prevail. Yet the penguins, seals, sea-lions, and sea-elephants which contrived to maintain a hold on life in those inhospitable regions represent types of animal life which it was our bounden duty to preserve. A hope has been expressed that Macquarie Island may be set apart as an inviolable sanctuary for Antarctic life, and we trust not only that this will be done, but also that steps will be taken to guard against marauders who may be tempted to make occasional raids for the sake of the profits to be gained. To this end the island might be used for the purposes of a biological and meteorological station. Before it is too late we hope that the matter of protection for the whales in the Antarctic seas will also speedily find a place on the Statute-book. The subject has been long under consideration, but as yet nothing has been done on account of the opposition of commercial interests.

DURING 1919 many meteorological features of special interest occurred, and some of these introduced problems well worth discussing. In July and October the weather was exceptionally cold and dry over the British Isles, and the rainfall in both months for the whole country was only 55 per cent. of the normal for the thirty-five years ended 1909. The cold in the autumn was quite remarkable. The Greenwich observations show that the mean temperature for the year was 48·8° F., which is 1·3° colder than the normal for the thirty-five years ended 1915; the mean maximum temperature was 56·7°, and the mean minimum 40·9°. May, June, August, and December were the only months with an excess of temperature. The warmest month was August and the coldest February. There were four months, February, July, October, and November, with a deficiency of temperature amounting to 4° or more. December was 2·4° warmer than the normal, and 3·4° warmer than November, when there were only five days with 50° or above, whilst December had thirteen such days. The total rainfall for the year was 23·4 in., which is 0·1 in. less than the normal. December was the wettest month of the year, and the other months with an excess of rain were January, February, March, and April. The driest month was May with 0·36 in. March and December both registered precipitation on twenty-two days; during the year precipitation was measured on 175 days. Bright sunshine was registered for 1489 hours, which is eleven hours more than the normal for the year. May had the greatest duration of sunshine, 268 hours, and December the least, 21 hours.

THE Report of the Director-General of Public Health, New South Wales, for the year ended December 31, 1917, has recently reached us. It contains the usual full statistical data of the health of the State, and reports on the work of the microbiological laboratory. The latter is chiefly devoted (pp. 150–280) to an exhaustive inquiry on an epidemic of acute polio-encephalo-myelitis. Some 134 cases occurred, mostly in children, of whom 94 died. The chief features were fever in all cases, convulsions in many, and paralysis in a few, with rigidity and mental lethargy, confusion, and drowsiness as a rule. The disease was proved to be the meningitic or cerebral form of acute poliomyelitis (infantile paralysis, Heine-Medin disease).

IN the Journal of the Royal Society of Antiquaries of Ireland (vol. xlix., part 3, June, 1919) Mr. H. S. Crawford publishes a well-illustrated article on the mural paintings and inscriptions at Knockmoy Abbey, which are now partially destroyed, but once covered the entire northern wall of the chancel of the abbey church. The writer adduces arguments to show that they probably date from the sixteenth century. "At an earlier period pictures would hardly have been allowed in a Cistercian church, and at a later the costumes of the figures and the forms of the inscriptions would probably have been different."

IN the Journal of the Royal Anthropological Institute (vol. xlix., 1919, January–June) Prof. F. G. Parsons presents the results of his anthropological examination of a number of German prisoners of war interned in England. He thus states his conclusions: "The more one thinks of it, the more one is convinced that since the sixth century the broad-headed Alpine race has been slowly and steadily supplanting the long-headed Nordic type, not only in Prussia, but in every part of Germany, and the prisoners at our disposal give no reason for thinking that there is any part of Germany in which the Alpine or Slav characteristics have not dominated the Teutonic or Nordic." This view is based on head and face shape and coloration, and, so far as the evidence goes, it is supported by that of stature. The tall provinces are in the north and west of Germany, while the shorter men inhabit the south and east. Curiously enough, after what we have heard of the Pomeranians, they are a short race, the average height being 5 ft. 6·4 in. Of course, it is possible that the exceptionally tall men were drafted into special corps, such as the Guards and Marine Artillery, and that these were not fully represented in the material at the Prisoners' Bureau.

SIR E. BRABROOK has reprinted from the *Anglo-French Review* for October an interesting article entitled "The Anthropological Institutes of France and the United Kingdom." The Société d'Ethnologie de Paris was founded in 1839, and the Ethnological Society of London in 1844. In 1859 the Société d'Anthropologie de Paris was founded by Pierre Paul Broca, and the Anthropological Society of London by James Hunt in 1863. The London society had at first a chequered career; the question of the plurality of races had a political bearing, and some communications made to the society on the characteristics of the negro race were thought to overstep the line which restricts scientific societies in their choice and treatment of subjects for discussion. The question was finally solved by the foundation of the Anthropological (now Royal Anthropological) Institute of Great Britain and Ireland in 1870, which has since enjoyed a useful and prosperous career, though it has never received a State grant such as is enjoyed by its French sister, and has not obtained adequate support from those interested in the problems of our Indian and Colonial Empires. A project has recently been initiated for the establishment among the anthropologists of the Allied nations of a permanent central office of the International Institute of Anthropology, a scheme which, if framed on satisfactory lines, will do much to co-ordinate the work now carried on in Great Britain and on the Continent. Whether Germany will ultimately be invited to share in this organisation depends on the future conduct of that country.

PROF. A. KEITH's important twenty-first Robert Boyle lecture, entitled "Nationality and Race from an Anthropologist's Point of View," has been published by the Oxford University Press (price 2*s.* net). Prof. Keith begins by classifying the progress of human culture into two stages: that of natural and artificial subsistence. "Man's great bowel, including the cæcum, appendix, and colon, which answered his needs well when his dietary was coarse and uncooked, is ill-contrived to deal with foods which are artificially prepared and highly concentrated." The thesis which he proposes is that "in our modern racial strifes and national agitations we see man's inherited tribal instincts at war with his present-day conditions of life." This he illustrates by a survey of racial and national problems in the United States, Canada, Spanish America, Australia and New Zealand, South Africa—where "the problems of race and of nationality appear in a more acute and tangled form than anywhere else in the world"—and Europe, and by a reference to the Jewish question. As regards the Irish problem, Prof. Keith remarks that, "except for a trick of speech or a local mannerism, the most expert anthropologist cannot tell Celt from Saxon, or an Irishman from a Scotsman. There are, to be sure, certain physical types which prevail in one country more than in another; but I do not know of any feature of the body or any trait of the mind, or of any combination of features or traits, which will permit an expert, on surveying groups of university students, to say this group is from Scotland, that from Wales, the third from Ireland, and the fourth from England." Prof. Keith ends by a strong plea that a knowledge of tribal and racial spirit is essential for statesmen.

PROF. W. TRELEASE discusses the bearing of the distribution of some elements of the existing flora of Central America and the Antilles on former land connections in this area (Bull. Geol. Soc. Amer., No. 29, pp. 649–56). The most important evidence is supplied by the genus Agave, which includes the familiar century plant. Its chief centre is Mexico, but it ranges from Arizona to the Isthmus of Panama, and occurs also in tropical Florida and northern equatorial America. It is represented in the West Indies by about fifty endemic species comprising six distinct types, and from their distribution in the islands the author concludes that the genus was derived from the mainland of Central America at some late Tertiary or early Quaternary time when islands and continents were continuous. Later they spread through the chain over continuous land; the continuity was broken by subsidence or faults when the very deep Anegada Passage, which separates the islands of St. Thomas and St. Croix, was formed, and later subsidences have caused in succession the deeper and lesser water gaps by which the Antilles are divided into groups successively more or less distinct in their Agave flora. These conclusions harmonise with the fact indicated by Eggers: that the greatest break between the northern and southern elements in the Antillean flora coincides with the deepest, and presumably the oldest, break in the Antillean bridge, now represented by the Anegada Passage.

THE geological work on the Western Front forms the subject of an interesting paper by Mr. W. B. R. King in the *Geographical Journal* for October (vol. liv., No. 4). Mr. King was Geologist at General Headquarters in France for more than three years. His problems were mainly concerned with water-supply, which at times presented much difficulty in view of the amount required. The advice of the geologist was also of great importance in mining and tunnelling operations and in the construction of dug-outs.

WE have received a copy of the Rain Map of Australia for the year 1918, published by the Commonwealth Government. It gives the total rainfall for the year and separate maps for each month. Some small inset maps show the areas with rainfall above the average in recent years. The year 1918 was in marked contrast to the two preceding years, both of which had an unusual amount of precipitation. In some respects it resembled 1915, when there was severe drought in the interior of New South Wales and Queensland. Rainfall was good until the end of February, when drought set in over the central and eastern parts of Australia. The westerly, or, as this chart names it, the Antarctic, rainfall in the south seems to have been fairly normal, but its influence was restricted to the coasts in the south-west and south-east. South Australia suffered from drought, and throughout the wheat-belt there was a serious deficiency in spring rains. A cool spring, however, minimised this want, and cereal crops were fairly good

in Western Australia, South Australia, and Victoria, but largely a failure in New South Wales and Queensland.

THE shortage of potassium salts and nitrates during the war has directed attention to many possible sources of supply previously neglected. In Memoir 14 of the Geological Survey of South Africa Messrs. Frood and Hall discuss the deposits of saltpetre found as an interstitial filling along the bedding planes at the base of the valleys in a region of hard ferruginous shale near Prieska and Hay, Cape Province. No satisfactory estimate is available of the average composition and depth of the deposits. Nitrification of the animal excreta accumulating near the sheltered portions of the cliffs is believed to be the source of the nitrate, which then passed in solution along the joint planes, producing irregular encrustations and pockets. If this be the correct explanation of their origin, it is improbable that the deposits could be of any great depth.

THE Summary of Progress of the Geological Survey of Great Britain for 1918 (issued in 1919) is of special interest through its description of the bauxitic nature of certain Carboniferous strata in Ayrshire. A clay of Millstone Grit age has been found to be a good refractory, with 26–30 per cent. of alumina, 28–50 per cent. of silica, and combined water 7·5–15 per cent. Most of the alumina is combined with silica, probably as kaolin, but there remains an excess, as in bauxitic clays. This excess is, however, not easily soluble in hydrochloric acid, unlike that in bauxite. Oolitic varieties of the bed contain most free alumina. Basaltic lavas underlie the clay, and the conditions that produce laterite and bauxite seem to have prevailed in southern Scotland in Upper Carboniferous times. The discovery and value of this material will stimulate observation in other localities of Carboniferous rocks. It is pointed out that the quality of the material may vary considerably, and that the presence of titanium dioxide, which occurs as rutile, in a greater proportion than 5 per cent. reduces the refractory property considerably. In the same Summary of Progress a record is given of the personal and official services rendered by the staff of the Geological Survey during the five years of war. Among others, our congratulations go out to Capts. E. B. Bailey and J. E. Richey.

IN a valuable paper read before the Royal Society of Edinburgh (Proceedings, vol. xxxix., 1919, pp. 157–208), Prof. C. G. Knott continues his investigations on the propagation of earthquake-waves through the body of the earth. In his new analysis Prof. Knott does not assume any relation between the velocity of propagation and the distance from the earth's centre. His work, which must have been most laborious, leads him to the following conclusions. He finds that the seismic rays of both the condensational and the distortional waves are concave outwards until they reach a depth of about three-tenths of the earth's radius. To this depth, then, the velocity of propagation must increase with the depth. It then becomes nearly constant, but at still greater depths it decreases a little, so that the rays there are slightly convex outwards. The data furnished by seismological observatories enable him to trace the rays to a depth of six-tenths of the earth's radius, but not beyond. At or near this depth the distortional wave seems to die out, for at arcual distances of more than 120° from the epicentre their characteristic appearance in our seismograms is lost. Dr. Knott thus arrives at a conception of the earth's interior which is practically the same as that advanced by Mr. Oldham thirteen years earlier: that the earth consists of an elastic solid shell down to a depth of about half the earth's radius, that here the rigidity breaks down, and that at a depth of about six-tenths of the earth's radius the elastic solid shell gives place to a non-rigid nucleus of measurable compressibility.

SOUTHPORT, by its report of the meteorological observations made at the Fernley Observatory during the year 1918 and discussed by Mr. Joseph Baxendell, the meteorologist to the Borough Corporation, adds much to our knowledge of the weather at one of the principal English health resorts. The report contains more than detailed observations of the weather, and now that the observatory has continued for forty-seven years the results yield values of much importance. Two local atmospheric pollution stations were started during the year, one to be representative of urban and the other of rural Southport. Hourly wind-direction-frequency normals are given numerically, as well as in diagram form as a frontispiece; they show a preponderance of southerly winds in the winter and of westerly and north-westerly winds from off the sea during the day-hours in the summer months. Mr. Baxendell hopes definitely to establish a marked and persistent meteorological periodicity of nearly 5·1 years, which, he states, is especially noticeable in wind direction. The year 1918 was marked by general warmth and wetness, resulting from a very abnormal predominance of winds from the warmer and more humid half of the compass (south-east through south to west). The table giving the rainfall with different wind directions shows that 78 per cent. of the total amount of rain was with winds from these directions.

THE Fifth and Sixth Reports of the Director of Veterinary Research of the Union of South Africa contain an account by Mr. H. H. Green of an improved method for the estimation of small quantities of arsenic by micro-titration with iodine. It was used for determining the fate of ingested and injected arsenic in sheep. Bacteria capable of oxidising sodium arsenite and reducing sodium arsenate have been isolated from arsenical cattle-dipping tanks. Examination of maize-milling products by dietetic experiments upon pigeons shows a close parallelism between the distribution of vitamine and phosphorus in individual maize-kernels, but not in different samples of maize. In the absence of information about the original grain and the extent of milling, microscopic examination would provide a safer test than the estimation of phosphoric acid. An extensive study of diets containing varying amounts of vitamine shows that the daily demand of pigeons for vitamine is not constant, but depends upon the extent of exogenous metabolism.

TECHNOLOGIC Paper No. 139 of the Bureau of Standards, Washington, U.S.A., contains an account of tests of light aluminium casting alloys. Among other tests, a number were carried out to determine to what extent the mechanical properties of cast alloys could be improved by heat treatment as follows:—Heating for two hours at 500° C., following by cooling in air, the specimens then being left to age several days before testing. Some thirty specimens were so treated, and in all but five or six cases there was a resulting increase in tensile strength of from 5 to 50 per cent. In cases where the heat treatment showed a decrease in strength, the whole group of bars of the heat was of inferior quality, cast and heat-treated ones alike. The hardness was increased by the heat treatment. The effect on elongation was more erratic, but in general a decreased elongation was found in the heat-treated specimens. It would appear that the treatment of light aluminium castings has commercial possibilities. Copies of the paper may be obtained by addressing a request to the Bureau of Standards.

THE *Technical Book Review Index* issued by the Carnegie Library at Pittsburgh, U.S.A., appears quarterly, and is a useful guide to new books on pure and applied science. The compilers have not had the actual books before them while preparing the index, but have obtained their information entirely from reviews that have appeared in scientific and technical journals. The accuracy of the information given depends therefore, in each case, upon the care taken in the review consulted. Books are arranged in the alphabetical order of the authors' names. The title of each book is followed by full reference to journals where reviews of the book may be found, and a short quotation from each review, giving, where possible, some idea of the scope and object of the work. The compilers have wisely refrained from expressing any opinion of their own as to the value of each book, although it appears that an attempt in this direction is made upon the index-cards of the library at Pittsburgh from which this review index has been prepared. It will, however, be found that the extracts quoted from reviews give, in most cases, adequate assistance in forming an opinion as to the merits of each work.

PHOTO-ELECTRIC activity seems destined to play an important part in technical photometry. In No. 349 of the Scientific Papers of the U.S. Bureau of Standards Mr. K. S. Gibson gives an account of experiments on photo-electric spectrophotometry by the null method, using potassium hydride cells now on the market. Such cells give a maximum response, usually near 460$\mu\mu$; consequently, the method admirably supplements the visual and photographic methods, being best in the blue and violet parts of the spectrum, where they become poor, and becoming poor only after they have become trustworthy. By employing the null method, first brought out by Richtmyer, errors due to want of direct proportionality between photo-electric current and exciting radiant power, and to the current through the cell when not irradiated, are eliminated. Experiments have also been carried out on diffuse spectral reflection, and the method is applicable to the measurement of the relative radiant power of two sources and to the measurement of fluorescence. In another publication of the same series (No. 344) Messrs. W. W. Coblentz and H. Kahler give data as to the change in the electrical resistance of the sulphide of silver and of bismuth when exposed to radiations of wave-lengths extending from 0·6μ to 3μ. Galena, cylindrite, pyrites, and jamesonite did not show any noticeable sensitivity. At very low temperatures the intrinsic sensitivity of silver sulphide was greatly increased—a result of interest in connection with the fact that some substances exhibit luminescence only at low temperatures.

PART ii. of a paper on the cutting power of lathe-turning tools was read at the Institution of Mechanical Engineers on December 19 by Mr. George W. Burley, of Sheffield University. Part i. was read in 1913 by Prof. W. Ripper, and a number of points raised in the discussion are dealt with in the present paper, which gives an account of the continuation of the series of experiments. Among the conclusions arrived at is the fact that there is no practical cutting speed below which it is impossible to obtain a satisfactory finished surface on plain-carbon steels by the use of tools of plain-carbon tool-steel, ordinary (non-vanadium) high-speed steel, or superior (vanadium) high-speed steel, but there are upper limits as follows:—For finishing mild steel, 48 ft. to 58 ft. per minute for each of the three varieties of tool-steel; for finishing hard steel, 23 ft. to 28 ft., 17 ft. to 21 ft., and 28 ft. to 34 ft. per minute respectively for the three varieties of tool-steel mentioned above. The cutting power of a high-speed lathe tool is influenced by both the cross-sectional area of the shank of the tool and the nose-radius, but the influence of the latter factor predominates. Thus, with a number of different sections of tool-steel, an increase of 100 per cent. in nose-radius produced an average increase of cutting power of 45 per cent.; whereas an increase of the shank cross-section of the tool of 500 per cent. with a constant nose-radius produced an average increase in the cutting power of only 8·5 per cent. There is no marked difference in the net amounts of energy required per cubic inch of material removed from mild-steel and hard-steel bars at high and low cutting speeds.

Messrs. Longmans and Co. expect to publish in January "Applied Aero-Dynamics," L. Bairstow; "The Design of Screw Propellers, with Special Reference to their Adaptation for Aircraft," H. C. Watts; "Telephonic Transmission, Theoretical and Applied," J. G. Hill; and vol. i. (The Extremities) of "A Manual of Practical Anatomy," Prof. T. Walmsley. Others books, in the press or in preparation, by the same house are:—"An Introduction to the Study of Terra Sigillata, Treated from a Chronological Standpoint," Dr. F. Oswald and T. D. Pryce; "Structural Steelwork," E. G. Beck; "Tuberculosis and Public Health," Dr. H. H. Thomson; "Food Supplies in Peace and War," Sir R. H. Rew; vols. ii. and iii. of "A Manual of Practical Anatomy," Prof. T. Walmsley; and, as already announced, "The Life and Work of Sir Jagadis Chandra Bose," Prof. P. Geddes.

OUR ASTRONOMICAL COLUMN.

THE BIRTH OF THE MOON.—Prof. W. H. Pickering in *Popular Astronomy* (October, 1919) endeavours to reconcile Sir George Darwin's estimate of the moon's age (less than 60,000,000 years) with recent geological opinion, which demands a period of 1,200,000,000 years since the formation of the earth's crust. He suggests that the matter of the moon left the earth at that remote epoch, but remained for ages circulating round the earth as a cloud of fragments. In this form its tidal influence would be small, and the earth would for long retain its assumed primitive rotation period of some four hours. Gravity in the tropics would be much reduced by centrifugal force. Prof. Pickering seeks thus to explain the existence of the huge reptiles like the Atlantosaurus and the Diplodocus, also the fact that heavy reptiles like the Pterodactyls had the power of flight. He suggests that the moon was consolidated from the cloud of fragments in the middle of the Cretaceous period, and quotes geological authorities for a great invasion of land areas by the sea and tremendous volcanic activity at that epoch, which he ascribes to the great tides which the moon would have raised when so near the earth. That epoch would agree well enough with Sir George Darwin's estimate of the moon's age, supposing it to date from its consolidation, not from its leaving the earth.

DISTANCES OF THE STARS OF TYPE F.—Mr. C. F. Lundahl discusses the distances of these stars in *Meddel. Lunds Astr. Obs.* (series ii., No. 21). He works on the same lines as Prof. Charlier in his recent memoir of the B stars; that is, he assumes a constant absolute magnitude, and deduces the distance of each star from its apparent magnitude. The F stars have a wider range of absolute magnitude than those of type B, but the great majority of them are included in a range of about 2 mag.; hence tolerable results for the distances may be expected. In fact, he states that 60 per cent. of the stars the parallax of which has been measured agree with his values within the limits of probable error. He quotes Prof. Plummer's research on the same stars, which was based on the assumption that they were moving parallel to the galactic plane. As that method showed an agreement with measured values for only 40 per cent. of the stars, Mr. Lundahl concludes that his own assumption is nearer the truth. He notes from his results that ζ Tucanæ and η Cassiopeiæ are evidently dwarf stars, while Polaris and still more Canopus are notable giants. The density of distribution of F stars is estimated by two independent methods, which give respectively 8 and 4 cubic siriometers for one star of this type (a sir. = 1,000,000 astr. units).

ABSOLUTE MAGNITUDE AS A FUNCTION OF COLOUR.—Mr. F. H. Seares indicates a relation between colour and absolute magnitude in stars of the same spectral type (Proc. Nat. Acad. Sci., July, 1919). The colour is determined photographically by taking graduated exposures of the star on an isochromatic plate with and without a yellow filter. The ratio of exposure times that give images of equal intensity in the two cases is a measure of the colour. The method has been tested on about 150 stars the absolute magnitude of which has been otherwise determined. The following are the results deduced:—Giant stars of types G and K are decidedly redder than dwarfs; also in type B the brighter stars are redder, but the difference is less marked. On the other hand, in type A the fainter stars are redder, while in types F and M the curve is too flat to permit of the absolute magnitude being found from the colour. Thus the method can be applied only if the spectral type is known, but it promises to be a useful supplement to the spectroscopic method. Experiments are being made to examine whether the necessity of knowledge of the spectral type can be evaded by taking three series of exposures with screens of different colours; if this were possible, the method could be applied to much fainter stars.

CROSS-CIRCULATION AS A PHYSIOLOGICAL METHOD.

IN the mutual co-ordination and integration of the physiological processes in a complex organism, in which actions exerted by the environment on a particular part affect the whole and the functional activity of one organ has its influence on numerous others, there are two chief methods adopted. One is by means of the central nervous system, in which messages received from the periphery along certain nerve-fibres are reflected back, as it were, to outgoing nerve-fibres, setting into play the appropriate muscular or other response, it may be in a distant part of the organism. This method has been compared to a telephone exchange. The other is by means of the blood. Owing to the continual circulation of the same mass of liquid through all parts of the body, it will readily be seen that a chemical substance, produced in any one part and passing into the blood-vessels supplying this part, must be carried, sooner or later, to all other parts, and give rise to effects in any tissue or organ sensitive to it. We have here an actual transport of material, the materials carried, when they result in changes in distant organs, being known as "chemical messengers" or "hormones."

In many cases there is difficulty in discovering to which of these modes of communication a particular reaction is due. Thus when muscular exercise is taken, the depth and rate of breathing increase. We know that carbon dioxide is produced in the combustion process that affords the energy for the muscular work. This passes into the blood, and may be in itself sufficient to set into greater activity the nerve-centre controlling the muscles of respiration. On the other hand, it might be that sensory nerves in the muscle are stimulated by the movements, and that the appropriate message is conveyed by nervous channels, or both chemical and nervous factors may be involved. Perhaps a clearer case is that of the pancreas, which pours its powerful digestive juice into the small intestine as the food arrives there from the stomach. We know now that the chief, if not the only, way by which this co-ordination is effected is that the acid of the gastric contents causes the formation of a chemical messenger in the walls of the intestine. This, passing into the blood, ultimately reaches the pancreas and excites it to activity, but it was for a long time believed to be a nervous reflex. Again, the origin of wound-shock has recently been shown to lie mainly in the production in the injured tissues of poisonous compounds, which are carried by the blood to the rest of the body and cause widespread damage to the capillary blood-vessels, resulting in a failure of blood-supply throughout the body. At the same time the co-operation of nervous factors has not been altogether excluded.

The analysis of many problems of this kind has been greatly assisted by the various methods known as "cross-circulation." It is obvious that if we can make a connection between the blood-vessels of one animal (A) and those of another (B), any chemical messenger produced in A must affect B also, whereas a process in A brought about entirely by the nervous system will have no effect on B. In this mode of experiment the blood of A may either be allowed to circulate through the whole of B, and *vice versa*, or

some particular organ only of B may be supplied from A, this organ being cut off from the circulation of B. The details of the procedure cannot be described here, but some recent improvements in the technique may be referred to. The chief difficulty lies in the fact that when the blood comes into contact with any foreign surface that is wetted by it, such as the glass or india-rubber tubes connecting the two animals, clotting occurs. This may be obviated by making the blood incapable of clotting. A substance extracted from the heads of leeches will do this, but it is at the present time almost impossible to obtain it. Other substances having the same effect are too poisonous. Since the blood does not clot in the uninjured blood-vessels themselves, Hédon in France and Dale and Laidlaw in this country have made use of pieces of vein to connect the blood-vessels required. The latter workers desired only to divert the blood from one vein of an animal into another of the same animal, so that no great internal pressure was present, and it was sufficient to pass a short metallic tube (Crile's canula) over each end of the piece of vein, reflecting the ends over the tube and tying them. When this is done, and the tube is introduced into a blood-vessel, the blood comes into contact only with the lining of a normal blood-vessel. Hédon, wishing to connect the artery of one animal with that of another, took a metallic tube long enough to enclose nearly the whole length of the piece of vein and reflected the ends over this. The vein was thus adequately supported against the pressure of the blood in the arteries.

Bazett and Quinby, in the current issue of the *Quarterly Journal of Experimental Physiology* (vol. xii., No. 3), describe a method in which the fact is made use of that if blood is in contact only with a foreign surface not wetted by it, clotting is absent for a long time. They coated the interior of the glass and rubber tubes used with a mixture of paraffin and vaseline, and by interposing a specially constructed stopcock were able to connect the circulation of the two animals or return to normal at will.

These improvements in the technique of cross-circulation should render it possible to investigate problems hitherto difficult to solve. There is one disadvantage in it which must not be overlooked. This is the fact that a fall in the blood-pressure in one animal causes an inflow from the other when there is complete intercommunication between the two. Thus one of the animals may be seriously depleted if the low pressure lasts for any length of time. For this reason the production of wound-shock in one animal by the products of tissue-injury of another seems impossible, because the fall of blood-pressure, which is the most marked symptom of the state, would in itself drain blood from the normal animal and produce a similar state merely by loss of blood, apart from the action of a chemical substance. W. M. BAYLISS.

NICKEL-CHROMIUM STEEL FORGINGS.

DURING the war there was a considerable development of the use of alloy steels, in particular of those containing nickel and chromium. These uses were of the most varied kinds, not the least important being in the construction of internal-combustion engines used in aircraft, where service conditions are very severe. It is not surprising, therefore, that difficulty in complying with the specifications was encountered in manufacture, and much novel experience has been accumulated by technical workers in this field of steel metallurgy.

At the autumn meeting of the Iron and Steel Institute two important papers relating to this class of steel were presented: one was by Messrs. Andrew, Greenwood, and Green, of the metallurgical research department of Sir W. G. Armstrong, Whitworth, and Co.; the other by Mr. R. H. Greaves, of the research department, Woolwich Arsenal. It is interesting and significant to note that the latter paper is entitled "Metallurgical Communication No. 1, from the Research Department, Woolwich."

Messrs. Andrew, Greenwood, and Green, who took up the investigation of defects in the final tests of nickel-chromium forgings, have carried out their work in a most thorough and exhaustive way, following up the manufacture of these from the original casting to the finished article. It needs considerable courage for the investigators in a works to publish evidence showing manifest defects in the products of the firm's work, and the authors are to be commended for their honesty in taking this step. It is but rarely that such cases are met with.

The manufacture of a hollow forging may be divided broadly into three distinct sets of operations: casting, forging, and heat treatment. The authors emphasise the operation of casting as the most important of all, because any defects present in the ingot, generally speaking, persist throughout up to the final treatment. It is essential that not only the metal but also the mould-walls should be clean, and that all loose sand must be prevented from getting into the mould. As a method of assisting in the achievement of these results, the authors suggest the use of a tundish with sloping walls lined with basic material. They say that if the metal were run directly into this from the iron ladle, the sloping walls of basic material would act as a cleanser, since the slag would adhere to the sides of the dish. The cleansing action would be similar to that brought about with mercury when poured through a paper cone with a fine orifice at the bottom. They recommend that ingots should be cast wide-end up, and that the smallest size consistent with requirements should be used. They recommend further a high-ladle, but a low-casting, temperature, since this is found to be advantageous in cleansing the metal. The macrostructure of the ingot is determined by the temperature and method of casting. High-casting temperatures are to be avoided because they give rise to excessive segregation, ghost lines, etc., and coarse crystallisation.

The authors advise that, after casting, the ingot should not be allowed to cool more than is unavoidable, but should be solid forged as soon as possible. This breaks up the crystals, thus refining them. It also assists in the diffusion of the carbon and thus renders the mass more homogeneous. The effect is to produce a much stronger material the thermal treatment of which can be undertaken with greater safety. In carrying this out with large forgings, very slow heating up to the temperature range, 730–760° C., must be adopted. Above this the rate of heating may be quicker. The authors suggest further that they have obtained evidence that mechanical work can be overdone, and that the greater the amount the more prone is the tendency to a laminated fracture. A somewhat similar point was made by M. Charpy in a recent paper published on "The Hot Deformation of Iron and Steel." With regard to the final heat treatment the authors say that the temperature of oil-hardening appears to make little or no difference to the mechanical properties; *the* important factor is the time at the temperature in question. This should be as short as possible, since a prolonged heating even at 850° C. coarsens the grain-size and causes a deterioration in properties.

The paper by Mr. Greaves deals with the "temper brittleness" of a nickel-chromium steel containing 3·5 per cent. of nickel, 0·6 per cent. of chromium, 0·5 per cent. of manganese, and 0·25 per cent. of carbon. This term is applied to the condition induced

in such a steel by slow cooling from the tempering temperature, and is revealed by a low absorption of energy in the single-blow impact test on notched bars. The author has found that wide differences in the impact figure with almost identical tensile test results can be produced by suitable heat treatment. He has also found that whereas, after hardening, every tempering treatment involving a final rapid cooling from 600° C. or above produced good impact figures, a final slow cooling produced a considerably lower, and often a bad, impact figure; further, that in any given steel the degree of brittleness which can be produced by a given condition of tempering depends on the original hardening temperature. The higher this is, the lower is the impact figure. He has also found that reheating to about 520° C. produces brittleness, whatever the subsequent rate of cooling, and that this can be removed by reheating to between 600° C. and 670° C. and cooling rapidly.

These results can be explained on the assumption that a critical temperature or temperature range exists in the neighbourhood of 550° C., above which the tough, and below which the brittle, condition is stable. Quick cooling through this temperature retards this change, and the unstable tough condition is retained. Slow cooling results in the production of the stable brittle condition. If the tough material is heated to a temperature rather below the change point, the rate of change to the brittle condition is at a maximum, and brittleness results. The rate diminishes rapidly with fall of the temperature, and below 450° is negligible. Provided, therefore, the critical temperature is not exceeded, the rate of cooling after this reheating is immaterial. Mr. Greaves does not show any cooling or heating curves of his steel. Those published by Messrs. Andrew, Greenwood, and Green on a steel of approximately the same composition indicate that the carbon-change point on cooling occurs between about 490° and 465° C. The character of the curve obtained depends upon the initial temperature from which the steel is cooled. H. C. H. C.

CEPHALODISCUS AND THE ARCHICHORDATES.[1]

THE history of Cephalodiscus, dredged at 245 fathoms in the Strait of Magellan by the *Challenger*, and at first taken for an Alga, and then for a compound Ascidian, goes back only three dozen years. Moreover, the sole species (*C. dodecalophus*) held the field for twenty-one years before the other species made their appearance; but now, with Dr. Ridewood's memoir before us, the total number of species reaches from twelve to sixteen, though further research may reduce that number. It is noteworthy that whilst the majority group themselves around the South Pole, four occur in the Indian and Pacific Oceans.

In the present memoir Dr. Ridewood, already known as an authority on the subject, keeps to the classification adopted previously, the group Pterobranchia (Aspidophora of Allman) having three subgenera of Cephalodiscus, viz. Demothecia, colony branched, with a continuous cavity throughout the cœnœcium; Idiothecia, colony branched, but each aperture leading into a tube occupied by one zooid and its buds; and Orthothecus, in which the colony is cake- or cone-like, each aperture entering a tube holding a zooid and its buds. The author first treats of the structure of the zooids, the similarity of which throughout the whole series is noteworthy; only in the reduced male zooids of *C. sibogae*, Harmer, is there a divergence. This fact alone would give differences due to variations in the cœnœcium less weight.

Amongst other features of interest are the enlargements at the ends of the tentacles, for instance, in the original species, which the author terms "end-swellings with refractive beads," and it is curious that no special function has been assigned to them. Similar enlargements at the tips of the branchial filaments are prominent features in Filograna and the so-called Salmacina, and great weight has been placed on them specifically, and even generically, by certain observers. In all probability they are sense-organs in both groups, since they are not connected with secretion, nor do they perform the function of opercula in Filograna (a Serpulid), in which form they are present or absent with puzzling indifference, for the plasticity of the species is phenomenal. The changes in the character of the epithelium on the dorsal and neural surfaces of the arms, and on the two surfaces of the post-oral lamellæ, are probably due, as in other forms (*e.g.* the Serpulids), to differences in function. The length of the testis is thought by the author to be a specific character, but that of the ovary is not.

Details are given of a new species, *C. evansi*, a branched form, in which each ostium leads into a tube ending blindly in the middle of the branch. The other three species procured in the expedition were formerly known, viz. *C. nigrescens*, Lankester, *C. densus*, Andersson (which the author considers to be a variety of the next), and *C. hodgsoni*, Ridewood. Thereafter a discussion on the Demothecia occurs, the species being extremely difficult to distinguish either by cœnœcium or zooids, and it is possible that future observers may reduce the number of species, since the variations of both cœnœcium and zooids in a single species are considerable.

No new feature is given in connection with reproduction and development further than that the author thinks there is no certain relation between the number of arms and the sex, as Andersson did, and that in *C. hodgsoni* the short stalk of the egg spreads over the egg-shell. Males, females, and hermaphrodites are found in *C. hodgsoni*, *C. aequatus*, *C. nigrescens*, *C. solidus*, and *C. densus*, whilst no males have yet been found in *C. dodecalophus*, *C. levinseni*, and *C. gracilis*. In *C. sibogae* and *C. agglutinans* only males are known, and in *C. gilchristi* and *C. evansi* both sexes frequent the same colony.

The author makes no allusion to the systematic position of Cephalodiscus in zoological classification, or to the homologies of the organs which have received the attention of many zoologists in connection with that classification. Dr. Masterman's Archichordata (Trimetamera), therefore, stands as before, with its two classes (1) Hemichordata (*e.g.* Balanoglossus) and (2) Diplochordata (*e.g.* Phoronis, Cephalodiscus, and Rhabdopleura), though not without dubiety in certain aspects, which even the labours of Spengel, Weldon, Cori, Fowler, De Selys-Longchamps, Lankester, Harmer, Gilchrist, Ridewood, Schepotieff, Davidoff, Hill, Gravier, Pixell, and Roule have not quite elucidated. Much of the dubiety is connected with the notochord and the gill-slits. Dr. Harmer thought that the proboscis-vesicle and "heart," with the notochord, essentially agreed with the condition in Balanoglossus, as described by Mr. Bateson; but Dr. Masterman, keenly working at Actinotrocha, Tornaria, Phoronis, and the young forms of Cephalodiscus, held that the primitive types had a double notochord, and his beautiful and accurate drawings speak for themselves whatever interpretation may be put

[1] "British Antarctic (*Terra Nova*) Expedition, 1910. Cephalodiscus. By Dr. W. G. Ridewood. With 12 text-figures, 5 plates, and a map (Published by the Trustees of the British Museum (Natural History), 1918.) Price 12*s*.

on them. Dr. Harmer's notochord, proboscis-vesicle, and heart are Dr. Masterman's subneural gland, subneural sinus, and preoral sac respectively, and Masterman has demonstrated that the subneural gland of Cephalodiscus and the "Eicheldarm" of Balanoglossus occupy entirely different relationships from the surrounding organs in each case, and therefore cannot be homologous. In both Balanoglossus and Actinotrocha there is a large subneural sinus. The presence of pleurochords in Cephalodiscus, of lateral grooves in Tornaria, and of pharyngeal pleurochords in Rhabdopleura, terminating (as in Tornaria) in oral grooves, which Morgan has shown grow outward into serial pouches, are points of interest in connection with Dr. Masterman's view. Besides, in Balanoglossus there are other chordoid parts in addition to the notochord of Bateson and Harmer. Larval Enteropneusta, again, have a pharynx with simple, paired pleurochords terminating in lateral grooves. It has to be borne in mind that Davidoff describes the notochords and nervous system in certain Tunicates as arising from paired rudiments, and the same observation has been made by Brooks in Salpa. In any case, as Masterman shows, Roule's view that Actinotrocha is a trochophore cannot be held, since the cavity of the latter is a hæmocele, whereas the hæmocele of Actinotrocha is restricted to a small space between the cœlomic sacs. The whole subject is a complex one, yet it may be that further research will weld these diverse views into harmony. Meanwhile, Masterman's opinions have much in their favour.

The memoir concludes with a useful synopsis of the species of Cephalodiscus, and the five plates are excellently drawn and lithographed, the map at the end showing at a glance the distribution of the various species, the whole forming a worthy tribute to the methodical and patient industry of the author, who, along with Dr. Harmer, of the same great museum, has done so much to extend our knowledge of this very remarkable group. W. C. M.

THE ITHACA AGRICULTURAL EXPERIMENTAL STATION.[1]

AGRICULTURAL experts visiting the United States always include the Ithaca Experimental Station in their programme if they can possibly manage to do so, for it is one of the finest and largest in that country of large institutions. Incidentally also, it appeals to all who read and loved Fenimore Cooper in their younger days, for it is situated in the lake country, and still preserves some of the waterfalls and woods associated with his heroic, if somewhat mythical, warriors.

The reports before us are bulky volumes, each of a thousand or twelve hundred pages; they are in keeping in point of size with the whole institution. The list of the staff occupies four closely printed pages, and includes nearly two hundred names. The number of printed copies of bulletins, reports, etc., sent out during one year only was 3,014,000. The State grant was 450,000 dollars in 1913; it rose during the war to 779,401 dollars for the year 1917–18. An Englishman reading these figures, and realising how greatly the income of this one institution exceeds that of all English agricultural colleges and experimental stations put together, begins to gasp when he finds the acting Dean declaring:—"The greatest single need of the college at the present time is more funds for research"; and again, "In common with other colleges in the University, the College of Agriculture is suffering because of the inadequate salaries which members of the staff are receiving."

The investigations cover the whole field of agriculture, but as no summaries are given it is not easy to find one's way through them.

A large number of the bulletins deal with diseases and pests of farm and garden crops, devoting special attention to practical methods of coping with them. In this type of work the American investigator excels; we have scarcely begun to make provision for field-work in plant pathology in Great Britain, although a promising start has been made with the more fundamental investigations. An extended series of observations on the nodule organism (*Bacillus radicicola*) of soybean is given in Bull. 386; the general result is that nodule formation can be considerably checked or stimulated by the presence or absence of certain salts and by variations in the amount of soil-moisture. Chlorides, phosphates, calcium salts, and certain organic compounds such as sugars, starch, oxalic, lactic, and citric acids, increase the amount of nodule formation; increases in moisture-content had a notable effect also. On the other hand, nitrates, ammonia compounds, and sulphates reduce it, though they do not kill the organism.

The direct assimilation of certain carbohydrates by green plants is discussed in Memoir 9 (1916). Saccharose, glucose, maltose, and fructose are directly absorbed and utilised by plants (green maize, Canada field pea, timothy, radish, vetch, etc.); moreover, they produce a characteristic branched-root system. It is suggested that the absorbed sugar is largely utilised in the root itself, but little migrating to the stems and leaves; this diminishes the downward migration of the sugar produced by photosynthesis and leads to increased top growth. Certain plants, such as radishes, vetch, and Canada field pea, are able to utilise lactose, although this sugar has not been found in the vegetable kingdom. Curiously enough, however, galactose is toxic to green plants, although it is utilised by various fungi. The bearing of the results on the old question of the source of carbon for plants is obvious, and the author concludes, as Laurent did in 1904, that the organic matter of soil plays a direct part in the nutrition of green plants, and in certain circumstances, notably in glass-house work, this part may be very important.

The soil surveys of Oneida County (Bull. 362) and of Orange County (Bull. 351) are typical of this kind of work as done in America. They form interesting reading, and would be helpful to a young man wishing to settle on the land but uncertain to which part of the country to turn.

Costs of production of farm crops form the subject of an important investigation (Bull. 377, 1916). In 1912 and 1913 the average costs of producing oats per acre in New York State were respectively 23·51 dollars and 22·34 dollars per acre, *i.e.* 4*l.* 18*s.* and 4*l.* 13*s.* respectively. It is interesting to compare these figures with the Rothamsted data, where the cost in 1913 was 6*l.* 4*s.* per acre. In both cases one of the largest single items is labour; in New York State it was 3·60 dollars per acre (15*s.*), at Rothamsted 21*s.* 4*d.* per acre, although the rate of wages paid in New York was double that paid in this country. The New York yield was 33·5 bushels per acre, that at Rothamsted 48 bushels.

Bull. 338 contains an interesting study of fertile and infertile soil otherwise similar in character; it was found that the former more readily accumulated nitrates than the latter. The most obvious cause was the difference in compactness of the soil, the fertile being less compact and having a smaller volume-weight than the less fertile one. An extensive bacteriological

[1] Reports of the Agricultural Experimental Station, Ithaca, New York, for the Years 1914–17.

examination was made by H. J. Conn, but it led to no result, indicating the weakness of present-day methods. The bacterial numbers fluctuated with the moisture-content, as at other centres. Some interesting soil-moisture relationships are brought to light in Bull. 352 (1914). E. J. RUSSELL.

THE RAINFALL OF THE UNITED STATES.

PROF. ROBERT DE C. WARD, of Harvard University, contributes an article on "Some Characteristics of the Rainfall of the United States" to the *Scientific Monthly* for September. The article is essentially of a popular character, but it is dealt with in a strictly scientific manner, and references to the several works from which the information is selected are given throughout, so that a closer and more minute study can be made where thought desirable. Many of the characteristics dealt with are among the most important, and certainly the most interesting, associated with rainfall. There is an endeavour to explain the cause of the special characteristics, a feature in many discussions of the present day. It has often been said in the past, with respect to meteorology, that there are bricks enough, but that we now require builders. Those who have been familiar with meteorology for the last half-century note with satisfaction its practical development.

Referring to the annual and monthly rainfall, Prof. Ward associates the varying amounts with the tracks of cyclones and the general pressure distribution which constitute the rain-producing conditions. The ratio of wettest and driest years to the mean fall is given for the United States generally. Where the annual rainfall ranges from 5 in. to 30 in. the fall in the wettest years may be expected to amount to about 180 per cent. of the average, whilst in the driest years the total is not likely to be less than about 55 per cent. of the average. Years with precipitation above the mean are less frequent than years with precipitation below the mean. It is emphasised that it is always instructive to investigate the weather-map conditions in all cases of unusually wet or dry periods, and to follow especially the tracks of low-pressure systems.

Dealing with periods with or without precipitation, the article states that "over most of the country the number of consecutive rainy days has been between 10 and 20. . . . On the north-western coast (Western Oregon), where the rainfall is heavy and the cyclonic activity is marked, more than 30 days in succession (30 to 40) have been rainy. . . ."

It is said that droughts may occur anywhere in the United States, especially where cyclonic controls of precipitation are weak. There is a distinct relation between droughts and forest fires—"a pre-requisite of a forest fire is a drought."

The Government meteorological reports, such as the Annual Report of the Chief of the Weather Bureau and the Monthly Weather Review, give much valuable material with respect to rainfall. As a rough-and-ready classification of excessive rainfalls, mention is made of 10 in. or more in a month; 2·50 in. or more in twenty-four hours; and 1 in. or more in an hour. Referring to secular variation of rainfall, it is pointed out that trustworthy conclusions cannot be drawn, as few observations go back to 1850, and most observations date from later than 1870. A period of observations for twenty-five years, 1887–1911, for all districts of the United States "lends no colour to the theory of a cycle in precipitation," and curves for New England, the Western Gulf, and North Carolina for 1879–1911 "show no approach to uniformity of distribution in time or space." For non-instrumental evidence a study has been made of the "rings" of trees in Arizona and California, "it being assumed that the thickness of the annual layers of tree-growth gives an approximate measure of the annual amount of precipitation. . . . The fact that the 'big trees' have continued to thrive for three thousand years has been taken to indicate a remarkable uniformity of climatic conditions rather than a series of oscillations."

C. H.

RETIREMENT OF SIR OLIVER LODGE.

ON January 1 the City of Birmingham gave expression to its high appreciation of the work of Sir Oliver Lodge as Principal of the University. At a meeting in the Council House, at which the Lord Mayor (Alderman William Cadbury) presided over a representative gathering of the leading citizens, an illuminated address was presented to Sir Oliver and Lady Lodge. The address, which was read by Sir Gilbert Barling (Vice-Chancellor of the University), was as follows:—"To Sir Oliver Lodge, F.R.S., LL.D., and Lady Lodge: On the eve of your departure from Birmingham we desire to express to you our deep sense of loss, our sincere appreciation of your great services, and our warmest wishes for your happiness and well-being in your new home. To you, Sir Oliver, we owe much as a physicist. Your distinction has added lustre to our city. As academic leader you have started our University on its career with lofty ideals. You have done much to form public opinion as to the meaning of true education in all its forms and among all classes, and your ethical teaching has ever been directed towards social amelioration. You may be satisfied that your labours of nearly twenty years have left a deep and lasting mark on the community which you have so long adorned. To both of you we wish good-bye with the deepest regret, and our most kindly feelings accompany you."

Sir Gilbert added that it was the intention of the subscribers to present also more substantial evidence of their kind feelings in the form of a motor-car, and a jewel for Lady Lodge. He reminded his audience of the greatness of the task which Mr. Joseph Chamberlain had set before the first Principal of the University, and he bore eloquent testimony to the admirable way in which Sir Oliver had realised the ideals of that statesman and justified his choice.

Sir Oliver Lodge in his reply emphasised the debt which the city owed to those public-spirited men who had gone before. He hoped the city had become proud of the University which it had brought into being. It took a little time always to know what an institution was worth, but the University was the crown of the city. He referred to the difficulties under which the University had laboured through lack of funds, but he believed that a better day was dawning. The State and the city were co-operating to a greater extent than before. One of the first uses he proposed to make of his freedom was to visit America. He had often been asked to go, but had never before been free to do so.

THE CHIPPAWA-QUEENSTON HYDRO-ELECTRIC DEVELOPMENT SCHEME.

AMONG the whole of the world's sources of water-power the Niagara Falls stand in a position of unique importance. Not only is the gross capacity of 5,000,000 h.p a magnificent industrial asset of unrivalled proportions, but the actual development of the Falls at the present time has enabled

the Hydro-Electric Power Commission of Ontario to create the largest system of electric transmission in the world. There are altogether ten plants belonging to the commission in various parts of the province, aggregating 248,000 h.p., and supplying nearly 200 municipalities, to which Niagara contributes the supply for 118. The transmission lines comprise 455 miles of 110,000 voltage, double circuit, and 2100 miles of low tension. Such has been the achievement of the commission up to the end of last year.

There is now in hand a most important extension of this remarkable system. The Chippawa-Queenston project, as it is designated, will within a few years' time increase the serviceable capacity by from 200,000 h.p. to 300,000 h.p., and, ultimately, by 1,000,000 h.p. The first instalment of the work is expected to be ready by the spring of 1921, at an estimated cost of 5,000,000*l*. We gather the following interesting particulars of the project from a recent series of articles in the *Engineer*:—

Instead of the relatively small head (between 135 ft. and 165 ft.) of the actual Falls, it is proposed to utilise nearly the full difference in level, amounting to 330 ft., between the surfaces of Lakes Erie and Ontario. In order to effect this, a canal nine miles in length will be excavated so as to connect the Welland River with the Niagara River at Queenston, and the Welland River itself will be widened and deepened for 4½ miles from its mouth. The channel thus formed will deliver water to a power-house below the Falls under a head of 305 ft., which will enable 30 h.p. to be developed for each cusec of flow instead of the 14 h.p. per cusec which is all that is available from the existing installation. The mean velocity of flow will be 2 ft. per sec. in the Welland River and 6 ft. to 7 ft. per sec. in the canal, resulting in a discharge of 10,000 cusecs at low-water level.

The canal route lies mainly in the solid rock of the Niagara Limestone formation, with the remainder (1½ miles) in earth and loose material. In rock the cross-section will be rectangular, 48 ft. in width; in earth it will be prismatic, with a bottom width of 70 ft. and side-slopes of 1 in 1⅛, pitched with stone facing.

At the delivery end of the canal a forebay will be formed in solid rock 1000 ft. long, widening to 300 ft. at the extremity. Penstocks of riveted steel plates, 14 ft. in diameter and about 450 ft. in length, will extend down to the power-house at the foot of the river-bank.

The initial generating plant will consist of 4 to 6 units of 50,000 h.p. each. On each turbine-shaft there will be a 3-phase, 25-cycle, 12,000-volt internal revolving field generator of 43,900 kilovolt-amperes at a power factor of 85 per cent.

BRYSSON CUNNINGHAM.

THE ORGANISATION OF CHEMICAL INDUSTRIES.

AT the meeting of the London Section of the Society of Chemical Industry, held at Burlington House on Monday, January 5, two interesting papers were read by Mr. E. V. Evans and Dr. G. S. Walpole on the present position of the chemical industry of Germany. The authors of these papers were deputed to visit a number of important chemical factories in the Rhine Valley in the early part of last year. They are well-known chemists with considerable experience of chemical plant on a large scale. The information which they were able to disclose was valuable and suggestive. Mr. Evans and Dr. Walpole described the German chemical factories as being maintained in a state of perfection, but paralysed at the moment through lack of labour and raw materials. They contrasted the huge and well-staffed factories in Germany with the smaller equipments in this country, and dealt in particular with the manufacture of dyestuffs and intermediate products which has been developed in this country since the outbreak of war.

During the war the demand of the country for raw materials for war purposes was so great as to make it impossible to organise this new industry on a scale adequate to compete with the German chemical industry. The authors of the papers were satisfied that the ability and knowledge of British chemists were at least equal to those of their German competitors, but they directed attention to the fact that it was not possible in the long run for a number of firms in this country, each producing a limited number of products in comparatively small quantities, to compete successfully with the huge German factories, all amalgamated into one organisation and capable of turning out in a relatively small number of places the huge quantities of dyes required by the world.

To enable this country to retain the trade in dyestuffs and intermediates which were now being manufactured here, and to enable it to do a certain amount of export trade in these commodities, there must be an organisation comparable with that of Germany, and time would be required to build up such an organisation. Meanwhile, some protection against the importation of German dyestuffs and intermediate products was necessary, and the trade could not flourish until some of the existing Government restrictions were removed.

The action of the Government in licensing the importations of German dyestuffs was a useful measure and had been of great value. It is to be hoped that these important papers will stimulate the chemical trade of this country and the Government Departments concerned to study the better organisation of chemical industries here and to put forward some carefully considered scheme.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE break in the continuity of sectional proceedings due to war conditions had, to a great extent, prevented those interested in geology throughout the country from keeping in touch with one another, and full advantage was taken of the opportunity for reunion offered by the Bournemouth meeting. Although arranged at short notice, the standard of former years was well maintained in the communications presented, and every moment of the week was full of interest.

The district has long been famous for its geological features, and consequently much interest has been taken locally in this branch of science. As a result, the papers by Dr. W. T. Ord on the Tertiary rocks of the Hampshire basin and the erosion of Bournemouth Bay, coupled with Mr. H. Bury's contribution on the history of the Chines, gave rise to considerable discussion. Important records of the rate of marine erosion at the present time and in recent years were contributed by many of those taking part in the discussion, and the Borough Engineer's measurements taken a short time ago were confirmed by collateral evidence.

Mr. Reginald Smith's paper on the Post-Tertiary geology of the area round Bournemouth, with special reference to the worked flints collected from many of the beds, was introductory to a joint discussion with Section H, and produced a very animated controversy. An admirable exhibit of such flint implements was arranged specially for this meeting by Mr. Scott, and added point to many of the remarks.

A second joint meeting, namely, with Section D

(Zoology), on subjects of less local interest, stimulated the most important discussions held during the proceedings of the Section. Mr. C. Tate Regan initiated one of these on the past history of continents as indicated by the distribution of fresh-water fishes; and Mr. D. M. S. Watson, a second, on palæontology and the evolution theory. Mr. Watson submitted that the data of palæontology cannot suggest the mechanism of evolution in the way that experimental biology and genetics can, but any evolutionary scheme must be consistent with these palæontological facts. The fossil record shows that intermediate groups rarely occur between two types; that innovations in any form, once initiated, tend to persist; and that innovations only arise from the more primitive members of a stock, *i.e.* from those which have retained their evolutionary plasticity.

The suggestion offered from the palæontological argument is that evolution is due to the operation of a variety of non-correlated factors, and that the initiation of a great group may be brought about by a set of nearly contemporaneous saltations.

Most of the speakers who followed commented on conditions seen in the groups they were specially interested in, and cases of convergence, divergence, homoplasy, rejuvenation, and extinction were instanced from the biological and palæontological records, all of which had to be taken into consideration in formulating any scheme of evolution. As showing the difficulties to be overcome, the case of the great auk was mentioned. Here a well-known bird had become extinct, yet no reason could be assigned save by postulating that a racial senility had set in, with a consequent loss of plasticity. The difficulties confronting the explanation of extinction in former ages were correspondingly greater in that we could not know accurately the conditions prevailing at those times.

The consensus of opinion was, however, that a restatement of the palæontological record in the light of present biological experimental results had become necessary, and the hope was expressed that this discussion might stimulate some such work.

Two exceedingly valuable contributions on aspects of geological research in our Colonies were presented by Dr. Miller on the pre-Cambrian rocks of Central Canada, and by Mr. A. E. Kitson on the discovery of diamonds in the Gold Coast. The former paper records a reasoned attempt to place the correlation of the pre-Cambrian rocks of Canada on a sound basis. This is very important in view of the fact that many minerals of economic value are associated with that series. The author directed attention to certain points where he had altered former correlations of these rocks, and especially to the discarding of the term "Huronian." The reason justifying the changed nomenclature is that Logan's name "Huronian" included two series of rocks, and later writers have applied it sometimes to one set and sometimes to the other, thus leading to confusion. New names have, therefore, been adopted for each set.

Mr. Kitson's discovery of diamonds in the Gold Coast was made so recently that no estimate can be made of its ultimate importance. Unfortunately, the paper was read at the end of the sectional proceedings, and there was not sufficient opportunity for discussion of the many interesting points raised. The whole question of the conditions of production of diamond in Nature is again opened up by the fact that no important basic igneous rocks, like the kimberlite of South Africa, occur in the whole surveyed area of the Gold Coast. The specimens so far obtained were exhibited, and all were small, but exploitation of the diamantiferous gravels may lead to the discovery of larger and more valuable specimens.

Other interesting communications on British geology were presented by Prof. S. H. Reynolds on the Lower Carboniferous rocks of the Avon section, Clifton; by Dr. Evans on the correlation of the marine Devonian rocks of North Devon and Somerset; and by Prof. Kendall and Dr. Gilligan on types of faults in the Coal Measures.

Two important papers have been left for consideration until the end, though they were read at an early part of the proceedings. In such an interesting district from a geological point of view it was felt that the Sectional Excursions ought to bulk largely, and consequently the general arrangement of the programme was correlated with the excursions to be held during the meeting. The first day's programme, therefore, included a description of the Tertiary rocks of the Hampshire basin by Dr. W. T. Ord, and was followed by an excursion under his leadership to the Bournemouth cliffs, where the Lower Tertiary rocks were examined. This examination was continued, three days afterwards, by a visit to Barton and Hordle led by Mr. H. W. Monckton, when the Upper Eocene beds, long famous for their marine fossils, were searched by many of the party with considerable success.

The lecture by Sir Aubrey Strahan on the geology of the Mesozoic rocks of the Bournemouth area was introductory to visits to Swanage, Lulworth, and Kimmeridge, the first two led by the author and the last by Dr. J. W. Evans. On these various excursions the structures which dominate the whole trend of the southern coastline were demonstrated, as was the manner in which the effect of these structures had been modified by subsequent denudation. Several of the curious natural phenomena, such as Lulworth Cove, Stair Cove, Durdle Door, etc., familiar to most geological students through the activity of the Committee for the Collection of Geological Photographs, were fully explained in the field.

The classic section at Kimmeridge was visited on the day following the official termination of the meeting, but, none the less, a large party was led by Dr. Evans along a most interesting coast section.

ECONOMICS AT THE BRITISH ASSOCIATION.

AT the meeting of the British Association held in Bournemouth last September, Sir Hugh Bell presided over Section F (Economics), and in his presidential address emphasised the need for increased production, holding that by thus serving the common weal each one would at the same time be serving his own best interests.

In the discussion of problems of labour and capital a paper was read by the Right Hon. F. Huth Jackson on "The National Alliance of Employers and Employed." Comparison was made between the objects of the alliance and those of the Whitley Committees. While the latter stood for improvement in the commercial and working conditions in single industries, the former was also intended to bring together the employers and employed in all industries in a particular area with the object of improving not only the industrial, but also the housing, educational, and recreational conditions of the district.

Problems arising out of the war conditions were dealt with from three sides. The Hon. Sir Charles G. Wade approached the question of prices from the side of Government control, making special reference to the experience of Australia. The degree of success attained by the method of price-fixing during the war must not, he held, be taken as a guide for peace conditions. Apart from complete State control of indus-

try, the effect of price-fixing had always been, and inevitably would be, the creation of a scarcity of the article the price of which was fixed; and moreover, the regulation of the price of any one commodity would necessitate the application of similar control to every link in the chain of production of that article. The only way to maintain an adequate supply of capital and sufficient production under a system of fixed prices was to institute complete State control of all production and distribution, but this was impracticable. His remedy, therefore, was, while refraining from any control of prices, to apply publicity to costs and profits by means of profiteering tribunals.

Dr. J. C. Stamp was also on the track of the profiteer, but rather with the aim of making up the deficit in the national revenue. For this purpose he believed a substantial increase in the income- and super-taxes would result either in a hindrance to the accumulation of capital or in a great addition to working-class burdens, and was therefore inadvisable. Nor did he argue for the levy on capital, which would fail, he believed, to bring about distributive justice. His solution of the problem lay in the taxation of the profits of all businesses in excess, not of their own pre-war profits, but of a normal rate of interest on capital. He believed that in this way it would be possible to reach those businesses which, through good fortune, received abnormal profits, and therefore had a high capacity for bearing taxation without ill-effects to the community.

The elimination of the gold standard during the war destroyed the system under which gold and credit were interchangeable, and wrecked the stability of the system of debts based on the gold unit. The gold standard, Mr. R. G. Hawtrey maintained, must be restored, but this must be done with judgment. The business community was hostile to deflation through fear of contraction of trade; the sudden re-introduction of the gold unit and the reduction of the value of paper below its face value involved an increase in the burden of debts, which would bring serious difficulties; and the reduction of the gold value of the monetary unit below its former nominal value was open to the imputation that public faith had been broken. His argument was that to make possible an unvarying gold currency unit, without which the stability of debts was impossible, it was necessary that the demand for gold currency should be kept as steady as possible. For this purpose, international co-operation was required, with the object of stabilising the general level of prices as measured by index numbers, and of regulating the actual amount of note issue in each country. Such international co-operation need not be universal; the inclusion of the financially strong countries would be sufficient; and this could be begun so soon as the Anglo-American exchange could be brought to par.

ENGINEERING AT THE BRITISH ASSOCIATION.

AT none of the meetings of the British Association in recent years have such large numbers been attracted to the Engineering Section as at Bournemouth during the meeting in September last. Not only was the hall in which the meetings were held uncomfortably crowded almost throughout the whole of the proceedings, but on the last day many members were unable to gain admission. This was probably due to the fact that many of the papers were of a popular and descriptive nature, and dealt with matters of great interest in connection with the war. The authors in all cases were leading authorities who had been mainly responsible for the development of the special branches with which their papers dealt. The British Association, being for the purpose of the advancement of science among the general public, should encourage this type of paper rather than the highly specialised technical type which is better suited for the various learned and technical societies.

Prof. Petavel's presidential address was followed by the report of the Committee on Complex Stress. This report embodied six important papers by members of the committee, viz. the strength of tubular struts; stresses in aeroplane wing frameworks; the soap-film method of stress estimation; eccentric loading; effect of low-frequency alternations of tensile strength; and the strain energy function and the elastic limit. A summary of the work was given by Prof. Coker and Dr. Haigh.

Of the three papers read on the Wednesday, the first was "An Account of the British Tanks Used in the War" by Sir E. H. Tennyson-d'Eyncourt, the Director of Naval Construction, who traced the history of these devices from the war chariots of the ancients, through the one horse-power one-man "tank" of the Battle of Hastings, viz. the knight in armour, down to the highly developed vehicle which proved such a valuable ally to our infantry during the great war. The author dealt frankly with the thorny questions concerning the development of the Tanks from the time that they were first proposed to Mr. Churchill until they appeared on the Somme in September, 1916. The various types were explained and the reasons given for the successive modifications.

Prof. Inglis read a paper on portable military bridges, describing in detail the type of bridge with which his name is associated, and which proved so valuable in the final advance of our armies on the Western front. In connection with this paper a demonstration was given at the Christchurch bridging centre on the same Wednesday afternoon, when Inglis bridges of various types were constructed and used to convey Tanks across the river. The final paper on that day was by Mr. R. J. Walker, entitled "The Development of Geared Turbines for the Propulsion of Ships," in which the great advantages obtained by the substitution of turbines for reciprocating engines were clearly shown.

Thursday morning (September 11) was devoted to aeronautics, and opened with a paper on airships by Wing-Comdr. Cave-Browne-Cave, who discussed the questions of rigid and non-rigid types, fabric materials, gases, fire risk, etc. Mr. Bairstow, of the National Physical Laboratory, traced the progress of the scientific development of aviation during the war, and explained the various instruments devised for the investigation of the stresses on the aeroplane structure during various evolutions, and also of the inherent stability of aeroplanes when uncontrolled by the pilot. It would appear that although the factor of safety is ample for normal flight, it is reduced to a very small margin by unskilful handling in the air, and no aeroplane has yet been devised which could not be crumpled in the air by suitable mishandling. Col. Tizard dealt with the problem of the reduction of engine performance at a great height to a standard pressure, density, and temperature; at present this reduction involves a great deal of uncertainty. Prof. Bryan gave a summary of investigations which he has carried out on the sound emitted by air-screws when running with tip-speeds exceeding the velocity of sound. Under such conditions the sounds emitted at various parts of the revolution reach the ear simultaneously and give rise to unpleasant sensations. Capt. Rolleston West read an interesting paper on the application of air-brakes to aeroplanes so as to

enable them to make steep landings and short runs when alighting in a restricted space.

The morning of Friday (September 12) was devoted to electrical papers, and opened with a paper by Capt. J. Robinson on directive wireless telegraphy as applied to aircraft, in which, after explaining the principles involved, he described the various improvements developed mainly by himself during the war. This will undoubtedly find an extensive application, not only for aerial, but also for marine navigation. Prof. Fortescue explained the application of the three-electrode thermionic valve as a generator of high-frequency alternating current, and described, with the aid of numerous lantern-slides, the various arrangements adopted by the Navy embodying this device for the purposes of radio-telegraphy and telephony. Dr. Eccles followed with two papers describing special arrangements of three electrode valves, one being an improvement on the ordinary method of connection as explained in the previous paper, and the other a relay device whereby a snap of the finger and thumb several feet from a telephone receiver is caused to upset the stability of the device and operate a relay. A paper on the ignition of gases by hot wires was read by Dr. Thornton, who reported briefly on some unexpected results obtained, and indicated the lines along which the probable explanation might be found.

The final day opened with a paper by Comdr. Gwynne on submarine mining; our pre-war mining policy was referred to and compared with that of other countries, as was also our position at the outbreak of war. The author discussed the development of the various types of mines during the war in so far as was permissible. This was very aptly followed by a paper on the paravane or otter, which was devised by Comdr. Burney, and proved a very effective weapon against both mines and submarines. Mr. R. F. McKay, the author of the paper, also showed a number of kinematograph films illustrating the various stages in their manufacture and application. Prof. Thornton read a very interesting and suggestive paper on the relation between the thermal conductivity and the velocity of sound in insulating materials. The meetings concluded with a short note by Prof. Bryan on the improvement of the efficiency of radiators in the heating of rooms.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

IN Section H (Anthropology), which met under the presidency of Prof. Arthur Keith, communications were fewer in number than usual, as one afternoon's session was given up to an excursion to the museum at Dorchester. In quality, however, they were quite up to the average. The meetings were well attended, and, as a rule, a high level of discussion was maintained.

Several papers dealt with physical anthropology and questions relating to racial distribution. Prof. F. G. Parsons, in his paper on "Racial Characters of the Modern Briton," raised the question of the relative value and practicability in use of the various methods of estimating race. In discussing the value of the cranial index he insisted on the contrast between the typical German population and that of the British Isles; the modern Briton had, on the average, the lowest cranial index in Europe, while a methodical examination of German prisoners of war had revealed that the Germans, even in Schleswig-Holstein, were round-headed. The Germans, in association with their Pan-Germanic views, had refused to collect or publish the evidence which showed the facts.

Prof. H. J. Fleure, in a comparison of an ancient and a surviving type of man, recorded the survival in remote parts of Wales of a primitive type which, in common with those found in similar "nests" in Europe and North Africa, resembled in many ways pre-Neolithic types such as that of Combe Capelle. This type, it was suggested, may have contributed to a considerable degree towards the evolution of the Mediterranean and the Nordic types. Mr. L. H. Dudley Buxton submitted the results of measurements, both of the living and of ancient skulls, made in Cyprus. Both series of measurements showed a common differentiation into two distinct types.

An important communication on the Finnic problem by Mr. H. Peake dealt with the origin and relation of the Nordic and Mongoloid elements in the Finnic population in the light of a fresh examination of the archæological evidence. The first wave of these Mongoloid people would appear to have arrived in the Baltic region on the retreat of the Ice Sheet; towards the close of the Neolithic age they were driven northward by the arrival of the Nordic people in Scania and West Gothland. In the middle of the Bronze age further Mongoloid peoples were occupying the margins of the Finnish lakes. The present Nordic element in the population was traceable to an immigration of Nordic people from Sweden which took place about A.D. 1000.

Miss M. A. Czaplicka discussed the relation of history and ethnology with special reference to North Central Asia. The present classification for Eastern Europe and North and Central Asia was historical rather than ethnological, and an uncritical adoption of the history of the Jinghis Khan period had led to the use of such terms as "Mongolic type," although such an original type did not exist in the sense in which there was a "Tungusic" or a "Turkic" type.

In prehistoric archæology a communication by Dr. R. R. Marett described recent excavations in Jersey on the site of La Cotte de St. Brelade, and also in a recently discovered cave on the north coast of the island. In the latter, shells of various species, including *Astralium rugosum*, which is at present confined to southern waters, and pieces of antler, which Dr. Andrews is disposed to bring into close relation with Pliocene deer from Auvergne, have been found in hard breccia, associated with small stalactites of unique occurrence in the island. A communication from Mr. T. W. M. de Guérin described a sculptured human figure recently discovered on the dolmen of Déhus, Guernsey. There is evidence that the worship of the divinity represented existed for a very long period in the island, extending probably from the Æneolithic until well into the Iron age. In a joint meeting with Section C (Geology) Dr. Reginald Smith opened a discussion on the age of the flint implements of the Bournemouth district.

In Mediterranean archæology Prof. J. L. Myres described excavations on sites in Cyprus in 1913, among them being the necropolis at Lapathos on the north coast, in which a sequence of tombs was obtained covering the "early" and "middle" periods of the Bronze age. The date-marks showed that the "middle" period began not earlier than the twelfth dynasty of Egypt. Mr. Stanley Casson ably summarised the results of discoveries (mostly in Macedonia) made in the Balkans during the war. It is interesting to note that the evidence thus obtained goes to show that the early culture of Macedonia pertains to the north rather than to the south.

A number of papers dealt with primitive religious cults, amongst them being a detailed study of the death ritual of Eddystone Island of the Solomons by Mr. A. M. Hocart, and an examination of the

mother-cults of India by Dr. W. Crooke. Mr. Peake's communication on "Santiago: The Evolution of a Patron Saint" dealt with the survival of a menhir cult in the Iberian peninsula and its association and confusion with the cult of St. James.

In a joint meeting with the Psychology sub-section, Prof. Carveth Read read a paper on "Magic and Science," and the Rev. H. J. D. Astley a paper on the relation of primitive art and magic.

Papers of a general ethnographic character were few in number. Mr. F. J. Richards's paper on the Badaga clans of Southern India was a valuable and comprehensive study, which included a detailed account of an interesting and important harvest festival. Mr. E. W. Pearson Chinnery in his paper on "Stonework and Goldfields in New Guinea" described a number of stone objects, including pestles and mortars, which showed that the country was visited at some time, presumably in search of gold, by a stone-using people, differing in many respects from the present inhabitants. In a second paper Mr. Chinnery described the people of the hilly country of the interior, and maintained that there was in these regions an extensive Negrito element similar to the Mafulu described by Williamson.

An afternoon session was devoted to a visit to the Dorchester Museum, where the party was hospitably entertained by the Curator and Mrs. Acland. A visit was also paid to the Maumbury Rings, where the results of the excavations were explained by Mr. C. Prideaux.

REWARDS FOR MEDICAL DISCOVERY.[1]

I. DEFINITIONS.—Medical discovery may here be defined as being: (1) The ascertainment of new facts or theorems bearing on the human body in health, and the nature, prevention, cure, or mitigation of injuries and diseases of human beings. (2) The invention of new methods or instruments for the improvement of sanitary, medical, and surgical practice, or of scientific and pathological work.

II. REASONS FOR REWARDING MEDICAL DISCOVERY.—These are: (1) To encourage medical investigation. (2) To discharge a moral obligation incurred by the public for its use of private effort.

III. VARIOUS POSSIBLE TYPES OF REWARDS.—(1) Titles and honours given by the State, by universities, and by other public bodies. (2) Prizes and medals. (3) Patents. (4) Promotions and appointments. (5) Pecuniary awards by the State.

IV. GENERAL PRINCIPLES OF ASSESSMENT.—It will probably be agreed that in the interests of the public all medical discoveries should, if possible, receive some kind of acknowledgment or recompense. But in view of the very variable conditions, nature, and effects of particular investigations, it will often be difficult to assess the kind of recompense most suitable for each.

In the first place, a distinction should be drawn between *compensation* and *reward*. By compensation is meant an act of justice done for the purpose of reimbursement of losses; by reward, an act of grace in appreciation of services rendered.

The following different cases should next be considered:—

A. Discoveries involving pecuniary or other loss to an investigator, either by direct monetary sacrifice, or by expenditure of time, or by diminution of professional practice, without corresponding pecuniary gains. A great example is that of Edward Jenner, who occupied himself so closely with the investigation of vaccination against smallpox that he lost most of his medical practice, and also considerable sums in expenses. The plea for compensation in such cases is unanswerable; and in 1802 and 1807 Parliament fully acknowledged its obligations under this head by giving Jenner compensation in two sums of 10,000*l.* and 20,000*l.*

B. Discoveries which have increased the professional emoluments of the investigator by enhanced practice or other means. Such are, frequently, improvements in surgical operations or medical treatment, which lead to increased practice. Another case is that of serums, etc., which may have been protected and put on the market. Here compensation cannot be demanded, and pecuniary awards may be generally held to be unnecessary. On the other hand, honours are often, and justly, bestowed upon such work.

C. Discoveries which involve neither gain nor loss to the investigator. This class includes most of the good, and sometimes great, clinical, pathological, and sanitary discoveries achieved in the world. Here also compensation can scarcely be demanded, and honours are already often given; but pecuniary awards should be sometimes bestowed as an act of grace when the value of a discovery to the public (or to a Government) greatly exceeds the emoluments of the investigator; and this principle should hold even in the case of men who were directly paid for undertaking the researches which led to their discoveries, especially when such payment was (as usual) small and the resulting discovery great.

The following particular cases, which sometimes occur, should be specifically noted:—(1) Men who have refused lucrative posts in order to complete their researches. (2) Men who have refused to protect their work for fear of limiting its application. (3) Men who have carried out investigations for Governments for little or no payment on patriotic grounds.

The following considerations must generally be borne in mind:—

(*a*) Honours (which are always much esteemed) are usually given as much (or more) for clinical success as for medical discoveries, though the latter possess a far wider influence and application than do the former.

(*b*) When given for clinical work or for discoveries under class B, honours often confer distinct pecuniary advantages by enhancement of practice, but for discoveries under classes A and C they have no such effect, and cases are on record where they tend to reduce emoluments by unfitting recipients for certain posts.

(*c*) Most people enter the medical profession (at considerable expense) not only from altruistic motives, but also to make a living, and it is usually only at a later period that they take up scientific investigation—either from a sense of duty, or from predilection, or merely because a good opportunity offers. When, therefore, a man finds that his scientific work, however successful and important it may have been, has actually yielded him less emolument than he might have obtained from ordinary clinical work, he feels naturally discouraged, and his experience prevents young men of ability from following his example, and therefore tends to check the prosecution of studies which are of the highest value to humanity.

(*d*) In the public interest, then, this committee begs to insist upon the principles:—(1) That no medical discovery should be allowed to entail financial loss upon him who has made it. (2) That the compensation or reward which he deserves should be assessed

[1] Report presented by the Joint Committee of the British Medical Association and the British Science Guild on Awards for Medical Discovery. The members of the joint committee are:—*Representing the B.M.A.*: Sir T. Clifford Allbutt, K.C.B., F.R.S.; Dr. R. T. Leiper; Prof. Benjamin Moore, F.R.S.; Mr. E. B. Turner; and Prof. J. S. Haldane, F.R.S. *Representing the B.S.G.*: Lt.-Gen. Sir Alfred Keogh, G.C.B.; Col. Sir Ronald Ross, K.C.B., K.C.M.G., F.R.S.; Prof. W. Bayliss, F.R.S.; Dr. D. Sommerville; Sir Richard Gregory; and Lt.-Col. O'Meara, C.M.G.

as being equal to the difference between the emoluments which he has actually received and those which a successful clinician might have received in the same time.

This is obviously the principle which was accepted by Parliament in the case of Jenner in 1802 and 1807.

Additional reasons for insisting upon this principle are:—(1) That few medical discoveries are patentable. (2) That such discoveries seldom give good grounds for promotion or for administrative appointments in the public services.

V. PARTICULAR ASSESSMENTS.—Whether a particular discovery should receive a large or small assessment will depend not only on the considerations given above, but also on the following:—

(1) *Width of Application.*—For example, the work of many of the older anatomists, physiologists, and parasitologists, of Pasteur, and of investigators of immunity has affected most recent discovery. Discoveries on widespread diseases, such as the work of Lister, of Laveran, and of Koch, are often, though not always, more important than those on more limited maladies.

(2) *Difficulty of the Work Done.*—For example, the solution of a difficult problem requires more study and also more time and cost, and therefore deserves more recompense, than a lucky chance observation.

(3) *Immediate Practical Utility.*—A strong plea for State remuneration can be made on behalf of cases of this kind, unless they come under class B. It is strange that at present they never receive it, while academical recognition is also often not forthcoming for them.

(4) *Scientific Importance.*—Discoveries which are not of present practical utility may become so at any moment, and should obviously be included in the scheme if they are sound and of wide application.

Medical discoveries made by persons who do not themselves belong to the medical profession should be included in all schemes of reward.

Of course, each case must be judged on its merits, and the assessment will not always be easy.

VI. STATE AWARDS FOR MEDICAL DISCOVERY.—Honours, prizes, and medals, being bestowed by H.M. the King or by public bodies and learned societies, are acts of grace which are generally given after much consideration, and the committee does not purpose to consider them. But the subject of *pecuniary awards* lies entirely within its province.

During the last few years the British Government has disbursed an annual grant of about 60,000*l.*, under the Medical Research Committee, for subsidising *investigations in progress* authorised by the committee and carried on by workers selected by it. This grant does not remunerate discoveries *already made*, but proceeds upon the principle of payment for benefits *already received*, deserves close attention, and has been recognised in other countries.

We think that both principles are sound, but they apply to two different classes of research, and are, indeed, complementary of each other. Payment for prospective benefits is "good business" only when some return is almost certain; and for this reason subsidised researches must frequently deal with simple and straightforward questions, admitting of immediate experimental reply. But, as a matter of fact, most of the greatest medical discoveries were built upon a much more speculative and uncertain basis, and were achieved by men who neither sought nor received subsidies for those investigations—as, for instance, Küchenmeister, Jenner, Simpson, Lister, Koch, Laveran, Bancroft, Manson, Bruce, Mackenzie, and a score of others who have so greatly improved medical practice. Surely the State should encourage this class of investigation also, partly because it costs the State nothing in so doing, and partly because it seems to achieve the greatest results. And there is only one way to encourage it: by paying for discoveries when made. Payment for benefits received is always not only "good business," but also a moral obligation. There are at present hundreds of medical men and others in this country who possess the knowledge, the brains, and the opportunity for private independent discovery without subsidies, but do not attempt it because medical research work does not pay even when brilliantly successful. Let these men also be brought into the fold of research by offering them reward when they succeed.

We therefore suggest that, in addition to assisting investigations in progress, it is proper for the State to remunerate those of its citizens who have already conferred the benefits of medical discovery upon it, just as it is proper for a patient to pay his doctor. And this policy will be not only an act of justice, but also an act of wisdom.

Our proposals are in detail:—(1) That Parliament should follow the precedent of Jenner by paying *compensation* when due for losses incurred in achieving medical discoveries. (2) That Parliament should provide an annual sum, say of not less than 20,000*l.*, for life-pensions to be given as rewards to such of his Majesty's subjects as have made worthy medical discoveries, such pensions amounting to between 500*l.* and 1000*l.* a year.

Such pensions would be preferable to donations in capital, and the sums suggested would be sufficient, because men of science seek only such independence as will enable them to employ their talents in the manner they think best.

The procedure of allotment should be similar to that used for the Nobel prizes, and for the honours and medals of learned societies—that is, full particulars of the work of all applicants should be kept and considered.

Parliament grants large subsidies to soldiers and sailors, has appointed a Commission to consider awards to inventors, and allows patents. It should not, therefore, complain if the medical profession, which has done so much for the nation during the war, now asks for some similar consideration.

(This committee is concerned only with medical research, but recognises that similar awards should be given to workers in other fields.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—At the beginning of the coming term Prof. R. H. Yapp will take up his duties as successor to the late Prof. G. S. West in the Mason chair of botany, and Dr. William Cramp will succeed Prof. Gisbert Kapp in the chair of electrical engineering.

LONDON.—The following courses of advanced lectures in physiology are now commencing:—"The Regulation of Respiration" (Guy's Hospital, Borough, S.E.), by Dr. M. S. Pembrey and Mr. J. H. Ryffel, at 4.30 p.m. on Thursdays, January 8, 15, 22, and 29, and February 5, 12, 19, and 26; "The Reaction of the Blood and Acidosis" (St. Bartholomew's Hospital), by Mr. J. W. Trevan, at 4.30 p.m. on Wednesdays, January 28, February 4, 11, 18, and 25, and March 3, 10, and 17; and "Physiologically Balanced Solutions" (Physiological Laboratory of the University, South Kensington, S.W.7), by Mr. W. L. Symes, at 5 p.m. on Tuesdays, January 27, February 3, 10, 17, and 24, and March 2, 9, and 16. The lectures are

addressed to advanced students of the University and to others interested in the subject. Admission is free, without ticket.

Other advanced courses to be delivered are:—Six lectures on "The Physical Properties of Soil" (Imperial College of Science and Technology), by Mr. Bernard A. Keen, on Tuesdays at 4.30 p.m., beginning on February 3; and a course on "A General Survey of the Globe and its Atmosphere," with practical work (Meteorological Office, South Kensington), by Sir Napier Shaw, on Fridays at 3 p.m. during the second term, beginning on January 23.

DR. D. W. CARMALT JONES has been appointed to the chair of systematic medicine in the University of Otago, New Zealand.

MISS F. M. G. MICKLETHWAIT has been appointed principal of the Horticultural College, Swanley. Miss Micklethwait holds the diploma of the college, and was a Beit research fellow; she has published a number of papers on her researches upon chemical subjects.

IN connection with the London County Council's lectures for teachers on recent developments in science, a lecture on "Aviation" will be given by Lord Montagu of Beaulieu at King's College, Strand, W.C.2, on Tuesday, January 13, at 6 p.m. The chair will be taken by Major-Gen. Sir Frederick H. Sykes.

THE Civil Service Commissioners announce that an examination will begin on May 4 next for the purpose of filling ten vacancies for assistant examiners in the Patent Office. The examination will be confined in the main to candidates who have served in his Majesty's Forces, and will consist of a qualifying examination followed by interview by a selection board. The subjects of the qualifying examination are English composition, *précis*-writing, general knowledge, and *one* of the following: General chemistry, electricity and magnetism, mechanics and mechanism. The limits of age are twenty to thirty. Initial salary 150*l*. a year, together with a war bonus. Copies of the regulations and forms of application may be obtained by writing to the Secretary, Civil Service Commission, Burlington Gardens, London, W.1. The last day for making application is March 4.

IN a pamphlet on college studies, published by the Stanford University of California, Prof. H. W. Stuart, professor of philosophy in the University, points out that the old discussion on the relative merits of literary and scientific studies in the training of a well-educated man has now become the problem whether citizenship in the modern world can be based on the contemplation, criticism, and enjoyment of life, or whether it requires a capacity for constructive participation in the activities of life in addition. It is remarked that while a literary education supplies a direct acquaintance with the characteristic interests and experiences of life, and a scientific education a knowledge of the means and machinery of life, neither recognises adequately those interests which find expression in the family, amongst friends, in play, or in the responsibilities of citizenship. Culture, in Prof. Stuart's opinion, expresses a personal capacity for conduct, not the body of knowledge of which the person makes use. It must comprise both literary and scientific discipline and study and experience of social science. The evidence of culture in an individual is the proper fulfilment of his functions in the society in which he lives, and each age must have its own standard of culture.

SOCIETIES AND ACADEMIES.

LONDON.

Aristotelian Society, December 15, 1919.—Prof. A. N. Whitehead in the chair.—Dr. G. E. **Moore**: External and internal relations. The most important part of what is meant by those who say that no relations are purely external seems to be the proposition that *every* relational property belongs *necessarily* to every term to which it belongs *in part*. This proposition is false, the truth being that *some* only among relational properties belong necessarily to those terms which possess them. To say that the property P belongs necessarily to the subject S is to say that from the proposition, with regard to any term, A, that it has not got P, it *follows* that A is numerically different from S. And this has been falsely taken to be true of every P and every S, because it is, in fact, true that from the proposition "S is P" it *follows* that any term, A, which has not got P is, *in fact*, other than S. The proposition that if p is true, then the conjunction "q is true and r false" *must* be false, has been compared with the proposition that if p is true, then "q is true and r false" is *necessarily* false in the sense that r *follows* from q. From the proposition "from 'p is true' it *follows* that 'q is true and r false' is false," it does not follow that, if p is true, then r *follows* from q.

Geological Society, December 17, 1919.—Mr. G. W. Lamplugh, president, in the chair.—Prof. S. J. **Shand**: A rift-valley in Western Persia. Asmari Mountain, near the oilfields of Maidan-i-Naftun, in the Bakhtiari country of Western Persia, is an inlier of Oligocene limestone among the beds of the Fars system (Miocene), the latter consisting, in the lower part, of bedded gypsum with intercalated shales and a few thin limestones. The mountain is a whale-back, formed by a simple symmetrical anticline plunging at both ends. The north-western end plunges rather steeply, and shows no abnormal structures; but at the south-eastern end the fold has collapsed along its length for a distance of three miles, letting the gypsum-beds down into a trough in the limestone. This trough is bounded by two main faults hading north-eastwards and south-westwards respectively, with an average hade of 20°, and marked by steep escarpments. The gypsiferous beds which once completely filled the trough have been partly removed by erosion, clearly revealing the fault-walls in the lower part of the valley.

MANCHESTER.

Literary and Philosophical Society, December 16, 1919.—Sir Henry A. Miers, president, in the chair.—C. E. **Stromeyer**: The study of nationalities. Although structural peculiarities are very useful for differentiating non-related species, they are of little use for the purpose of classifying branches of one species, and it is necessary to study their characteristics. There are very marked differences amongst the characteristics of different nationalities, *i.e.* the Semitic and Slavonic races have wonderful memory gifts, and the Scandinavians are pre-eminently inventive. The author dealt with the vague words employed in defining various characteristics and with the reagents which might be employed for revealing fundamental characteristics of different nationalities.—W. J. **Perry**: The historical process. The study of the geographical distribution of peoples in various stages of culture, and of the migrations of peoples, suggests that the degree of civilisation possessed by any community that has advanced beyond the pure hunting stage is the result, direct or indirect, of cultural influences propagated from some original centre. It seems as

though the fundamental arts and crafts of civilisation were invented in one place, and that the knowledge of them was carried to the outlying parts of the earth, thus producing the various degrees of culture possessed by different communities. The study of archæological remains supports this contention. If this conclusion be accepted, it becomes possible to regard the study of human society from a point of view different from that commonly adopted. We can examine the effects of various social institutions on behaviour. The hunting tribes, the most primitive men of whom we have direct knowledge, display a uniform type of behaviour: they are peaceful, truthful, monogamous, honest, kind to children and animals, and thus, presumably, represent the normal type of human behaviour. The people above them in culture have adopted the institutions of civilised peoples to varying degrees, and their modes of behaviour appear to correspond to their historical experience. The wide range of culture which exists in the world makes it possible to examine in detail the effects upon human beings of various social institutions, and thus to pave the way for the foundation of a science of society, the ultimate aim of which will be to determine which institutions are fitted to develop men to the greatest possible extent.—Prof. F. E. **Weiss**: Green jade work by natives of New Zealand.

PARIS.

Academy of Sciences, December 8, 1919.—M. Léon Guignard in the chair.—A. **Laveran**: Obituary notice of Prof. R. Lépine, correspondant of the Academy of Sciences.—C. **Moureu**, C. **Dufraisse**, and P. **Robin**: The stabilisation of acrolein. Part 4. Compounds hindering the formation of disacryl.—C. **Richet**: Injections of gum or of plasma after bleeding. A criticism of a recent communication by M. Barthélemy. The animal must have lost more than 70 per cent. of its blood before the injection of solution or plasma, or its survival cannot be regarded as decisive.—V. **Grignard**, G. **Rivat**, and Ed. **Urbain**: Researches on the chlorination of methyl formate and methyl chloroformate. Details of a semi-industrial method for the preparation of the ultimate chlorination product, CCl_3CO_2Cl.—M. Paul Janet was elected a free Academician in succession to the late M. Landouzy.—G. **Valiron**: Regular ensembles of zero measure.—M. **Mesnager**: Elementary solution of the rectangular plate fixed at the edges, carrying a load uniformly distributed or concentrated at its centre.—E. **Belot**: Possible causes of the light curve and the pulsation of Cepheus.—I. **Tarazona**: Observation of the solar eclipse of November 22, 1919, at the astronomical observatory of the University of Valencia, Spain. The first contact was found to be 8·4 seconds earlier than calculated.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the second quarter of 1919. Observations were made on eighty-one days, and the results summarised in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Ed. **Fouché**: Search for a characteristic equation applicable to atmospheric air. The equation is of the Clausius form,

$$\left[p+\frac{\psi}{(v+n)^2}\right](v-b)=\mathrm{RT},$$

in which ψ is a function of the temperature only. The constants n, b, R are determined from experiments by Witkowski, pressures ranging from 1 to 130 atmospheres and temperatures from −145° C. to +100° C.—G. A. **Hemsalech**: The origin of luminous radiations emitted by vapours in an electrical resistance tube furnace. The spectrum results from two independent emissions, one of which is of thermal and the other of electrical origin.—P. **Jolibois**: An apparatus for rapidly mixing homogeneous liquids.—E. **Mesnard**: Cyclonic formations of the atmosphere.—Ph. **Flajolet**: Perturbations of the magnetic declination at the Lyons Observatory (Saint-Genis-Laval) during the first and second quarters of 1919.—L. **Blaringhem**: Floral anomalies observed in hybrid plants from *Linaria vulgaris* × *L. striata*.—P. **Descombes**: The use of trees in extracting water from the atmosphere. Evidence from various sources of the increased deposit of moisture, as dew, caused by trees.—A. **Piédallu**: The *rôle* of iron in the blue *casse* of wines.—Mlle. Lucienne **Dehorne**: Hermaphroditism and scissiparity.—H. **Bierry**: Inanition, temperature, and glycemea.—A. **Richaud**: The action of ouabaine and of strophantine on the salivary secretion, and the mechanism of this action.—A. **Clerc** and C. **Pezzi**: The antagonism of adrenalin and quinine.—C. **Oberthür**: The symbiosis of ants and the caterpillars of Lycæna.—A. **Paillot**: Natural immunity in insects. Study of a case of humoral immunity.—C. **Nicolle**, A. **Cuénod**, and G. **Blanc**: Experimental demonstration of the *rôle* of flies in the propagation of trachoma (granular conjunctivitis).

CAPE TOWN.

Royal Society of South Africa, October 15.—Dr. J. D. F. Gilchrist, president, in the chair.—Sir Thomas **Muir**: Additional note on the resolvability of the minors of a compound determinant.—J. **Moir**: Colour and chemical constitution. Part ix. An empirical law of change of colour. The wave-lengths of the absorption spectra of all the halogen derivatives, and many other derivatives of phenolphthalein and fluorescein, can be calculated from the formula

$$\frac{n}{n_0}=\frac{\lambda_0}{\lambda}=1-0{\cdot}0115m-0{\cdot}000037m\,\mathrm{N},$$

in which n = frequency, λ = wave-length, m = number of halogens, etc., and N = atomic number of halogen in question. All the groups investigated have very similar effects on the colour, a most remarkable fact.—J. S. **Thomson**: South African Alcyonacea.

BOOKS RECEIVED.

Has the North Pole been Discovered? By T. F. Hall. Pp. 539. (Boston, Mass.: R. G. Badger.) 2.50 dollars net.

Glass Manufacture. By Dr. W. Rosenhain. Second edition. Pp. xv+258. (London: Constable and Co., Ltd.) 12*s.* 6*d.* net.

Cours de Chimie à l'usage des Etudiants P.C.N. et S.P.C.N. By Prof. R. de Forcrand. Deuxe. édition. Tome i. Pp. viii+437. Tome ii. Pp. 527. (Paris: Gauthier-Villars et Cie.) 14 francs and 18 francs respectively.

Democracy and the Press. By Dr. F. H. Hayward and B. N. Langdon-Davies. Pp. xii+76. (Manchester and London: The National Labour Press, Ltd.) 1*s.* 6*d.*

The School Geometry: Matriculation Edition. By W. P. Workman and A. G. Cracknell. Pp. xi+348. (London: W. B. Clive.) 4*s.* 6*d.*

Pensées sur la Science la Guerre et sur des Sujets très Variés. By Dr. M. Lecat. Pp. vii+478. (Bruxelles: M. Lamertin.)

Pre-Palæolithic Man. By J. Reid Moir. Pp. 67+29 plates. (Ipswich: W. E. Harrison.) 7*s.* 6*d.*

DIARY OF SOCIETIES.

THURSDAY, JANUARY 8.

ROYAL AERONAUTICAL SOCIETY (at the Royal Society of Arts), at 3.—Major H. E. Wimperis: How Airmen Find Their Way (Juvenile Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. H. Bragg: The World of Sound: Sounds of the Sea (Christmas Lectures).

PHYSICAL SOCIETY OF LONDON (at Exhibition of Apparatus, in conjunction with the Optical Society, at the Imperial College of Science), at 4.—Prof. F. J. Cheshire: Some Polarisation Experiments; at 8.—Prof. Rankine: The Use of Light in the Transmission and Reproduction of Speech.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—J. Shepherd: Failures of Turbo-Generators and Suggestions for Improvements.

OPTICAL SOCIETY, at 7.30.

INSTITUTION OF AUTOMOBILE ENGINEERS (at 28 Victoria Street), at 8.—T. Clarkson: Steam Vehicles.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Dr. F. M. R. Walshe: Forms of Peripheral Neuritis among Troops Serving with the Egyptian Expeditionary Force, 1915-1919.

FRIDAY, JANUARY 9.

GEOGRAPHICAL ASSOCIATION (at the London Day Training College), at 2.—Prof. R. N. Rudmose Brown: Spitsbergen.—At 6.—Sir Charles P. Lucas: Islands, Peninsulas, and Empires (Presidential Address).

ROYAL ASTRONOMICAL SOCIETY, at 5.—J. K. Fotheringham: The Longitude of the Moon from 1627 to 1918.—Prof. H. H. Turner: The Suggested Decrease of Period of Stars in Phillips's Group II., with particular notes on R Hydræ, S Tauri, U Herculis, R Aquilæ, χ Cygni, S Cygni, and S Coronæ Borealis.—Dr. J. L. E. Dreyer: The Original Form of the Alfonsine Tables.—C. Davidson and W. V. Woodman: An Equatorial Mounting for Eclipse Observations.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.—Sir Anthony Bowlby: The Application of War Methods to Civil Practice.

MALACOLOGICAL SOCIETY OF LONDON (at the Linnean Society), at 6.—Dr. S. S. Berry: A New Species of Mitra from California.—Dr. A. E. Boycott: Local Variation in Size of *Clausilia bidentata* and *Ena obscura*.—H. C. Fulton: Molluscan Notes, IV.

PHILOLOGICAL SOCIETY (at University College), at 8.—Dr. W. Perrett: The Perception of Sound.

SATURDAY, JANUARY 10.

GEOGRAPHICAL ASSOCIATION (at Regent Street Polytechnic), at 10.30 a.m.—Capt. C. E. Hodges: Demonstration of the Value of the Cinematograph in Geographical Teaching.

GEOGRAPHICAL ASSOCIATION (at the London Day Training College), at 3.—M. de Carle S. Salter: Rainfall as a Geographic Function.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. H. Bragg: The World of Sound: Sound in War (Christmas Lectures).

MONDAY, JANUARY 12.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Capt. H. Thomas: Geographical Reconnaissance by Aeroplane Photography.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Association), at 8.—A. R. Munro: Right-angle Belt Drives.

SURVEYORS' INSTITUTION, at 8.—E. M. Konstam and C. H. J. Clayton: Land Drainage from the Administrative and Engineering Points of View.

TUESDAY, JANUARY 13.

ROYAL HORTICULTURAL SOCIETY (at Vincent Square), at 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir John Cadman: Modern Development of the Miner's Safety Lamp.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—J. Mitchell: Whitby Harbour Improvement.—R. F. Hindmarsh: The Design of Harbours and Breakwaters with a View to the Reduction of Wave-action Within Them.—J. W. Sandeman: Wave-action in Harbour Areas; with Special Reference to Works for Reducing it at Blyth and Whitby Harbours.—W. Simpson: The Improvement of the Entrance to Sunderland Harbour, with Reference to the Reduction of Wave-action.

ROYAL PHOTOGRAPHIC SOCIETY and THE RÖNTGEN SOCIETY (at the Royal Photographic Society), at 7.—Major G. W. C. Kaye and Others: Discussion on Some Aspects of Radiology and Radiometallography.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Dr. A. C. Haddon: The Outrigger of Indonesian Canoes (illustrated by Lantern Slides).

WEDNESDAY, JANUARY 14.

ROYAL SOCIETY OF ARTS, at 3.—L. Pendred: Railways and Engines (Juvenile Lecture).

ROYAL UNITED SERVICE INSTITUTION, at 3.—Major A. Corbett Smith: The Traditions of the British Navy.

FARADAY SOCIETY, ROYAL MICROSCOPICAL SOCIETY, OPTICAL SOCIETY, and PHOTOMICROGRAPHIC SOCIETY, in co-operation with the Optical Committee of the British Science Guild (at the Royal Society), at 4.30 and 8.—Sir Robert Hadfield, J. E. Barnard, Sir Herbert Jackson, Prof. F. J. Cheshire, Prof. A. W. Porter, and Others: Symposium and General Discussion on the Microscope: Its Design, Construction, and Applications.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—Mr. Vivian: Thomas Campion: His Works.—Canon Westlake: The Gild of Our Lady of Rouncyval.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section) (at the Institution of Civil Engineers), at 6.—Capt. H. J. Round: Wireless Direction and Position Finding.

THURSDAY, JANUARY 15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. R. R. Terry: Renaissance Music in Italy and England (with Musical Illustrations).

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.

LINNEAN SOCIETY, at 5.—Dr. B. Daydon Jackson: Methods of Botanic Illustration during Four Centuries (Lantern Lecture).

CHEMICAL SOCIETY, at 8.—L. E. Hinkel and H. W. Cremer: The Condensation of Acetoacetic Ester with *p*-Dimethylaminobenzaldehyde and Ammonia.—G. S. Butler and H. B. Dunnicliff: The Action of Alcohol on the Sulphates of Sodium.—M. Nierenstein, C. W. Spiers, and in part the late K. C. R. Daniel: Guarana Tannin.—R. Lessing: Studies in the Composition of Coal: (1) The Behaviour of the Constituents of Banded Bituminous Coal on Coking; (2) The Mineral Constituents of Banded Bituminous Coal.—P. Ray and P. V. Sarkar: The Hydrazino-thiocyanates of certain Divalent Metals.

FRIDAY, JANUARY 16.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting) (at the City and Guilds (Engineering) College), at 7.—J. H. Reyner: The Development of Automatic Telephony.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir James Dewar: Low Temperature Studies.

SATURDAY, JANUARY 17.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—A. Noyes: The Anglo-American Bond of Literature.

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Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.